

ANNALS of SURGERY

A Monthly Review of Surgical Science and Practice

Edited by LEWIS STEPHEN PILCHER, M.D., LL.D., of New York

and WALTER E. LEE, M.D., of Philadelphia

Recorder of the American Surgical Association

SEMICENTENNIAL OF THE AMERICAN SURGICAL SOCIETY, 1879-1930

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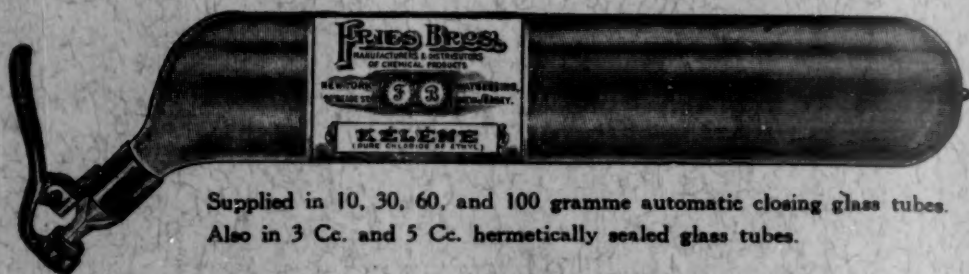
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TRANSACTIONS OF THE AMERICAN SURGICAL ASSOCIATION

SEMICENTENNIAL MEETING HELD IN PHILADELPHIA, PA., MAY 15, 16 AND 17, 1930

ADDRESS OF THE PRESIDENT FIFTY YEARS OF THE AMERICAN SURGICAL ASSOCIATION

BY FRED B. LUND, M.D.
OF BOSTON, MASS.

TO BE intrusted with the presidency of the American Surgical Association, which we love so well, membership in which was the goal of our youthful efforts, and which has been so many years, to use the words of its distinguished founder, "the altar on which our best contributions to surgery were laid," filled me first with bewilderment and then with a sense of my own inadequacy. The only repayment I can make for this great honor, which has in the past been given to some of the greatest leaders of our profession, is to attempt to give in my address a brief history of our Society, especially of the earlier years. In the time at my disposal, much, as you will too well realize, must be left out. When your historian speaks as he ought, make the most of it; when he fails, forgive him, remembering that he deeply appreciates the honor of your choice. As Doctor Gerster said, under similar circumstances, and as Horace said before him, "*Principibus placuisse viris non ultima laus est*," which may be translated, "To have pleased the leaders of our profession brings with it no small satisfaction."

The year of 1879 was perhaps the most important in the history of surgical organization in this country of ours, for that year witnessed the birth of the American Surgical Association, the Philadelphia Academy of Surgery, and the New York Surgical Society. At that time surgery had not been divorced from general medicine. Probably all the leaders who founded the Association still did family practice; in fact, our founder used to pride himself on the importance of his medical practice to his knowledge of surgery. But the field was rapidly expanding, antiseptics had begun and surgery was soon to be a field large enough, much too large, for the undivided efforts of any one man.*

* The first surgeon to devote himself entirely to surgical practice from the beginning was Dr. William T. Bull, of New York.

That great surgeon and teacher, Dr. Samuel D. Gross, then professor at the Jefferson Medical College in Philadelphia, realized the need of surgical societies for mutual instruction and interchange of opinion, and became the founder of the Philadelphia Academy of Surgery and the American Surgical Association, throwing in for good measure the Pathological Society of Philadelphia. An adequate portrayal of that truly remarkable man would overtax the limits of my address, but a brief sketch must be undertaken.* Doctor Gross was born in Easton, Pennsylvania, in the year 1805, of German parentage, the so-called Pennsylvania Dutch, and their peculiar dialect was his native tongue. He had therefore to begin his professional studies by learning English. He began to study medicine at seventeen as apprentice to a local practitioner, but soon found that he needed preliminary education. He deliberately stopped his medical work for two years and attended an academy at Wilkes-Barre, where he studied Latin, Greek, English and German. At nineteen he began again the study of medicine, which he carried on without interruption for sixty years. So excellent was his grasp of languages and so great his industry that ten months after his graduation in the third class which was graduated from the Jefferson Medical College, he had translated four medical treatises from French and German into English. He wished to begin practice in Philadelphia, but could not afford to spend the necessary time. So he went to work in his native town of Easton, where he soon acquired a practice. In addition to this, he carried on dissections, even driving to Philadelphia, a distance of fifty miles, and bringing back as a companion in his buggy a cadaver for that purpose. He also carried on research requiring animal experimentation. His work attracted attention, and in 1833 he was called to Cincinnati to be Demonstrator of Anatomy in the Medical College of Ohio. At that time it took sixteen days by stage and steamboat to get from Easton to the "Queen City." Here he remained four years and published his "Elements of Pathological Anatomy," the first publication of its kind in the English language, which attracted the favorable comment of the great pathologist Virchow and won its author great renown.

In 1840 he became Professor of Surgery in the University of Kentucky. Here he did much experimental work on wounds of the intestine. In 1856, having refused an invitation to the professorship in the University of Pennsylvania, he came to Philadelphia as Professor of Surgery in the Jefferson Medical College, for he could not refuse the call of his beloved Alma Mater. Here he spent the remainder of his life. In his introductory address he said, "Whatever of life and of health and of strength remain to me, in the presence of Almighty God and of this large assemblage, I dedicate to the cause of my Alma Mater, to the interest of medical science, and to the good of my fellow creatures." This oath he faithfully kept.

* More adequate biographies have been written by the venerable Doctor Keen and by Dr. John Gibbon, his successors in the professorship at Jefferson, to which I refer those of you who have not read them already, and from which I have obtained much of the material for this sketch.

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His contributions to surgical literature were varied, constant and important. Among them, besides his monumental "System of Surgery," were papers on "Foreign Bodies in the Air Passages," on "Diseases of the Urinary Bladder," and whatnot. He was the first to advocate abdominal section in rupture of the bladder, the use of adhesive plaster extension in fractures of the legs, amputation in senile gangrene, and the suture of divided tendons.

He was a man of majestic figure and handsome face, kindly in his judgments, genial, and, above all, industrious beyond belief. He loved men as well as medicine, illustrating the saying of Hippocrates that where there is the love of mankind, there is the love of our art. His personality was most impressive. Dr. W. W. Keen, in an argument in our Society on the importance of hearing rather than merely reading lectures, to illustrate the force of character behind the statements of Doctor Gross, quotes him on the subject of arthritis as saying, with appropriate gestures, "The treatment of inflammation of the joints, gentlemen, is rest; in God's name, gentlemen, rest."

Doctor Mastin writes: "Of commanding presence, with a full, deep voice, master of his subject, thoroughly in earnest, methodical in arrangement, simple yet forcible in expression, never for an instant at a loss for a thought or a word, he was an ideal lecturer; and no other American surgeon has so impressed himself upon medical students and upon so many." In the first years of his professional life, besides his translations which are mentioned above, he was the author of a "Treatise on the Anatomy and Physiology of the Disease of the Bones and Joints," and, in 1839, of the "Elements of Pathological Anatomy."

Such was the founder of our Association, a man who, had he been an ancient Greek, would have been deified at his death, like Æsculapius, and who, as will be seen later, certain members of the Society wished to invest with the purple, and make president for life. He had long desired the establishment of an association which should "bear a national name and embody in an harmonious whole the surgical talent, experience and wisdom of our great country."

Up to that time the American Medical Association had been the clearing-house for American Surgery, and naturally the proposal for a surgical association was made at a meeting of the Association in Atlanta in 1879. Doctor Gross spoke to three of his colleagues, who heartily approved of the plan, and on the following day a meeting was called, at which five leading surgeons from Pennsylvania and the South and West were present, but none from New England, which cannot share in the glory of the birth of our Society, though it soon began to play an important part in its affairs. Those present were Moses Gunn, Professor of Surgery in the Rush Medical College; William T. Briggs, Professor of Surgery in the University of Nashville; W. W. Dawson, Professor of Surgery in the University of Ohio; and L. A. Dugas, the venerable Professor of Surgery in the University

of Georgia, who was chosen chairman of the committee; all professors of surgery—all, so to speak (at that time) frontiersmen, and all pioneers. A circular was sent out to representative surgeons "soliciting their coöperation in the founding of a national surgical society, to consist of distinguished surgical practitioners, writers and teachers, at a meeting to be held in New York at next year's meeting of the American Medical Association." In New York about fifty surgeons assembled, organized and adopted a constitution less than two pages in length, from which we gather that the objects of the Association should be the "cultivation and improvement of the art and science of surgery and the promotion of the interests not only of its fellows, but of the medical profession at large." Fellowship requirements consisted of an age of at least thirty years, graduation from a respectable (sic) medical college, and a reputation as a practitioner, author, teacher, or original observer. Forty-four surgeons signed the constitution.* Samuel D. Gross was elected president and J. R. Weist of Richmond, Indiana, recording secretary. Doctor Weist served as the very efficient secretary of our Association for twelve years, until 1893, and the Association owes him an enormous debt of gratitude.

The next meeting was at Richmond, Virginia, in May, 1881, during the meeting of the A. M. A. After dealing with problems of organization, the Society adjourned to meet in Coney Island in September of the same year. Here for the first time papers were read. Dr. John H. Packard reported "Œsophagotomy without a Guide," "Wound of the Soft Palate," "Infrahyoid Pharyngotomy"; Dr. Kinloch, "A Case of Supposed Aneurysm of the Posterior Tibial Artery." Dr. S. D. Gross read a paper on the "Influence of Operations upon the Prolongation of Life and Permanent Recovery in Cancer of the Breast." No transactions were published.

On May 31, June 1 and 2, 1882, was held the first regular scientific meeting, of which the transactions were published in the same form that they have continued for nearly fifty years. Twenty-five fellows registered and fifty gentlemen from different parts of the country were elected to active fellowship. Fear had been expressed that the Association would harm the Surgical Section of the American Medical Association. Doctor Gross denied this in the following words; "We can hurt no society now in existence or likely to come into existence. We hope to make the American Surgical Association an altar upon which we may annually lay our contributions to Science, and so show to the world that we are earnest and zealous laborers in the interest of human progress and human suffering." He claimed and it has been proven true that the American Medical Association would be strengthened by the new society. At this meeting New England began to see the light and Doctors Cheever, Fifiield, George W. Gay and J. Collins Warren, of Boston, were proposed for membership, and at a subsequent meeting were duly elected. They were soon followed by Doctors Hodges, Homans, M. H. Richardson and others.

* Of the forty-four only one, Dr. W. W. Keen, is now living.

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It was fitting that this meeting should be held in Philadelphia, the home city of the founder. After wandering about like Leto with the twins, the real birth of the Society, full-fledged and with transactions, took place in this city, where we now celebrate its fiftieth anniversary. The meeting took place just when antiseptis and asepsis were under discussion. It was natural that antiseptis should not at first be successful, for it depended on killing the bacteria with carbolic acid and on the exclusion of air, while not all of those who undertook its ritual realized, as did its illustrious founder, the importance of cleanliness. It was not until several years later that this basic principle of cleanliness was thoroughly understood. A notable paper at this meeting was by James L. Cabell on "Sanitary Conditions in Surgery." It was a plea for Listerism. In the animated discussion which followed, Dr. J. W. S. Gouley stated, "While not a Listerist, I am, as you know, a good sound antiseptist. I cannot conceive of getting good results from hermetically closing wounds after amputations and excision of tumors. I do not think Listerism is going to die. It is dead. Few surgeons will long continue to use it." Dr. R. A. Kinloch replied, "Listerism is not dead. I believe we are going to hear more of it." Dr. George W. Gay showed by his discussion that the so-called antiseptic method had not been thoroughly carried out. Doctor Yandell said in the discussion, "In ovariectomy it has been thoroughly demonstrated. The strongest point seems to be the success and reliability of Dr. John Homans, of Boston."

It is interesting to note the part that Doctor Homans' early laparotomies evidently played in establishing antiseptis in this country. I cannot help digressing a moment to say a word about Doctor Homans, "honest John," as he was called. Surgeon to the northern army in the Civil War, skillful, intelligent, blunt and kindly, careful of his records, and brave as a lion, I feel sorry for the younger men of the Society because they have not the precious memory of him which we older men have. In preparing this address I have been again filled with admiration for the character of his work. At this time he had reported forty-seven cases, with only four deaths, under Listerism. "Many of the participants in the discussion," wrote Doctor Mears later, "felt called upon to deny that either they or any of the surgeons in this or that city employed the system or in any way approved of it." The writer of one of the papers in closing the discussion said, "the great objections came not from those who have tried Listerism, but those who are willing to raise their right hands and swear to God that they have never used it or witnessed its application." By one, the prophetic words, quoted above, were uttered to the effect that antiseptic methods in surgery were not dead, but that we were yet to hear more of them in the future.

The fifth annual meeting was held in Washington in 1884. Doctor Gross might have been reelected president, had he not absolutely refused the nomination. In fact, in discussing the matter, Doctor Yandell spoke as follows: "Had the constitution conferred upon us the power, we would have put upon him the royal purple, and, hailing him chief among all, had him

wear it for life." Doctor Gross, however, rightly felt that the honor should come to a different man each year, and so be more widely distributed. Dr. E. M. Moore, of Rochester, N. Y., was elected president, and addressed the Society on the "History of Medicine." Doctor Gross was ill at home and his paper on "Wounds of the Intestine," on which he had worked up to the very time of the meeting, was read by Dr. T. G. Richardson. The following telegram was sent to Doctor Gross: "The American Surgical Association has listened with pleasure and profit to your paper, regrets your absence, and sends you the sympathy of its fellows and their hope for your speedy recovery." On the fourth day of the meeting another telegram was sent, which said: "The fellows of the American Surgical Association are unwilling to depart until they are able to learn whether the hope for the improvement of your health has been realized." Three days later Doctor Gross entered into his eternal rest, full of years and honors. He left behind him this Association, strong and successful, which has ever since and will, we hope, forever be an honor to his memory.

At the sixth annual meeting in Washington in 1885, Dr. John B. Roberts, of Philadelphia, read a long and thorough paper on the "Surgery of the Human Brain," which included cerebral localization, middle meningeal hæmorrhage, and cerebral tumor, which the writer states should be operated upon when accessible. Christopher Johnston, of Baltimore, read a paper on "Diagnostic Laparotomy," the first appearance on our records of the exploratory operation. There was a symposium on "Gunshot Wounds of the Intestine" and some members were recorded for and some against operative treatment. At this meeting in 1885 the first of the foreign honorary fellows were elected. These were Paget, Lister, Erichsen, Annandale, von Volkmann, von Nussbaum, von Esmarch, von Czerny, von Billroth, von Langenbeck, Ollier and Verneuil. Dr. J. Collins Warren spoke on the "Healing of Arteries in Man and Animals after Ligation," which was a real contribution to the subject, based on clinical and experimental work.

The next year Dr. Harold C. Ernst spoke on "A Consideration of the Bacteria of Surgical Diseases," based on cultures made in Doctor Warren's wards. The common bacteria of suppuration, staphylococcus aureus and albus, were described, also the organism of erysipelas, "very similar under the microscope and in its behavior to staining reagents to the others, but there is quite a difference in the appearance of the colony." P. S. Conner, of Cincinnati, read a paper on "Tetanus," in which he concluded that the cause of the disease must be a virus from breaking-down tissue, or a germ—a very careful discussion which went as far as one could before the bacillus was discovered.

In 1888, Dr. W. W. Keen reported three successful cases of cerebral surgery, including the removal of a large intracranial fibroma. These were a pleasant contrast to the almost uniformly unsuccessful cases previously reported in our Transactions. This meeting was in Washington and was the first meeting with the Congress of American Physicians. At the meeting of

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our Association in 1886 Dr. Claudius H. Mastin had proposed the holding of this Congress. His proposal was adopted by the Society and through his efforts and that of a committee appointed at that time it was brought about. Its value to the associations composing it and to American Medicine can hardly be exaggerated.

It is interesting in looking over the record to find that in some of these early meetings of the Society only four papers were presented at a meeting. This was in order that there might not be too many for adequate discussion, which our founders considered very important. Doctor Senn used frequently to write papers of two hundred and fifty pages, on such topics as "Surgery of the Pancreas" or "Gunshot Wounds of the Intestine," in which he did pioneer work. Other subjects that he treated were "Air Embolism" and the "Relation of Microorganisms to Surgical Disease." Senn's plates we all remember, and how soon they were superseded by Murphy's button! Verily, there were giants in those days. Today we have many more papers and some of the shortest are the best. In the words of the old minister to the young candidate on the length of sermons, "Few souls are saved after the first fifteen minutes."

In the early days of the Society long tables were placed at the end of the papers, giving all the examples of the operation collected from literature. This was a tremendous task, but supposed to be necessary to establish mortality. It did so, but the mortality was bound to be high and the statistics uncertain on account of the varying conditions under which the operations were done.

In 1889, Dr. David W. Cheever was president and made a presidential address of notable literary quality, entitled "The Future of Surgery without Limit," from which I quote: "Long since it was said that all was found out and that Anatomy and Surgery had nearly reached their limit. Far from this, the microscope has created a new anatomy and a new pathology. Anæsthesia enlarged surgery. Antisepsis emboldens surgery, and we can set no limit to the advance." The three sacred cavities, the abdomen, which means hidden, the thorax, which holds two feet of the tripod of life, the skull, which conceals the nerve force, the vital principle, are all explored. He gave under the heading of operations as yet *subjudice*: "Resection of the pylorus, resection of cancerous intestine, of omentum; removal of the spleen, of large bronchoceles, of the larynx, the pancreas, the prostate gland, the normal ovary; fixation of the kidney, of the uterus; puncture of the pericardium; opening gangrenous abscesses in the lungs; tapping of the ventricles of the brain." It is easy to see that all these except the removal of the normal ovary are recognized procedures today. In fact, today, surgery has even extended to the last remaining glandular structure, the adrenal gland, and the last remaining system, the sympathetic nervous system.

Dr. J. Collins Warren spoke on the "Early Diagnosis of Malignant Disease" and presented the "Mixter Punch." Dr. George W. Gay spoke on "Heaton's Operation for Hernia." It is interesting to note that at that time

the "injection of infusion of white oak bark" was taken seriously as a treatment.

In 1890, Dr. W. T. Bull spoke on the "Radical Cure of Hernia" and reported one hundred thirty-four operations with three deaths. He deprecated undue haste in reporting results, and advocated high ligature of the sac without suture of the ring. In a notable discussion in 1895 on hernia Doctor McBurney condemned his own operation as having thirty per cent. of failures and advocated the operations of Bassini and Halsted. His attitude toward his own operation was a striking example of scientific honesty, and did honor to himself and to our Association. At this time operations for appendicitis in the interval began to crop up. Doctors F. S. Dennis and C. B. Porter spoke on the "Propriety of Removing the Appendix in the Interval," the first appearance of this subject. The first paper on appendicitis that I could find in the Transactions was read by Dr. W. T. Bull in 1888, entitled, "The Surgical Treatment of Typhlitis and Perityphlitis," although Fitz had suggested the name "appendicitis" in 1886. At the present time we might well discuss the propriety of the removal of the appendix from those who do not need the operation. At this meeting Dr. A. G. Gerster, that charming gentleman and eminent surgeon, sportsman and scholar, who had come to New York as an immigrant from Hungary and became one of America's leading surgeons, was proposed for fellowship.

In 1889, Dr. H. L. Stimson, one of the founders of the New York Surgical Society, and the father of our present Secretary of State, the Honorable Henry L. Stimson, in a paper entitled "Modifications in the Technique of Abdominal Surgery," limiting the use of the ligature *en masse*, reported four cases of hysterectomy with ligature of the uterine and ovarian arteries. This was a brilliant step in advance, doing away as it did with the old ecraseur and the external treatment of the stump, one of the saddest memories of our surgical youth. "Digital Divulsion of the Pylorus for Cicatricial Stenosis" by Dr. J. M. Barton described one of the first hesitating steps in gastric surgery.

In 1891, in Washington, Dr. Claudius W. Mastin was president and addressed the Society on "The Example and Teachings of Samuel D. Gross." He proposed a monument to his memory. A committee was appointed, and with the assistance of the Jefferson Alumni and a few private friends, the money was raised. The meeting of 1897 in Washington, when the statue was unveiled, was one of the notable meetings of the Association and will be discussed in due order.

Dr. A. G. Gerster's important paper on "Asepsis" illustrated the progress made since the early beginnings, and was perhaps the first to crystallize our present views. Among other things he noted the following fact, familiar to us all in the early days, "A clumsy and rough operator who is a thorough antiseptician is often very successful, while dexterous men meet disheartening discomfitures on account of disregard of the maxims of cleanliness. The living spark of truth has survived the pedantry and zeal of the advocates as

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well as the sneers and contempt of the opponents of the new departure." Doctor Gerster introduced Kraske's operation to the Society. He had done it seven times with one death.

Dr. J. C. Warren spoke on "Asepsis" at the large hospitals in Boston, with a description of the new laparotomy ward at the Massachusetts General Hospital, a remarkably well-equipped building at that time, when the peritoneum was supposed to need special aseptic precautions and was not, as at present, known to be less susceptible to infection than other parts of the body—the joints for instance.

Dr. M. H. Richardson, on the surgery of the gall-bladder, was ahead of his time for he recommends in favorable cases the excision of the gall-bladder, "though he has done it only once." For drainage he advocated suture to the abdominal wall over a wide margin.

Dr. S. J. Mixter, who afterward contributed so much of value to our meetings and became our president, read his first paper before the Society on "Dislocations of the Semilunar Cartilages." Dr. John B. Deaver advocated early operation in appendicitis. I am told that even now, after thirty years have passed, he still holds the same views.

In 1894, Dr. John S. Billings (by invitation) spoke on "Methods of Teaching in Surgery." He recommended that future surgeons should be trained in Bacteriology, Pathology and Physiology. He also suggested an occasional interchange of professors, an idea which has been so successfully carried out since.

At the meeting in 1895, Doctor Coley introduced the "Treatment of Inoperable Tumors with Toxins of Erysipelas and Bacillus Prodigiosus." Dr. L. McLane Tiffany was president and addressed the Association on "Intracranial Resection of the Gasserian Ganglion," and Dr. A. T. Cabot gave the *coup de grace* to castration as against prostatectomy.

The next year, 1896, Dr. DeForest Willard spoke on "X-ray Skiagrams" (sic), and X-ray reproductions appear in our transactions for the first time. Somewhat crude they were and concerned entirely with the bones and joints, but very interesting from the point of view of surgical history. The following year Dr. J. William White read a paper entitled, "The X-ray in Surgery," and "hoped that they might prove of use in fractures." Prophetic words! They have proved of use in fractures, and also of use to those prosecuting suits for malpractice, for like most good things they may do harm, especially if we look so keenly at the deformity in the picture that we are dissatisfied, even though the functional result leaves little to be desired. In 1903, the subject of X-ray as a therapeutic agent was brought up for the first time by Bevan and Coley.

In 1897, the Association met in Washington under the presidency of J. Collins Warren, and the statue of Samuel D. Gross was dedicated. This volume of the Transactions contains the photograph of the statue and the wonderful addresses of Doctor Mastin and Doctor Keen. It was one of the greatest meetings of our Society. Doctor Warren spoke on "The Influence

of Anæsthesia in Surgery." I quote his closing words: "The old Massachusetts General Hospital stands as it did in 1846, with its sightly Bulfinch dome and granite columns. From a scientific standpoint it seems an antiquated structure in comparison with the modern pavilion, wards, laboratories, and operating theaters which surround it, but it will never be torn down. It will always remain one of the conspicuous landmarks of this wonderful century, as a shrine of surgery sacred to that moment 'when the fiercest extremity of suffering was steeped in the waters of forgetfulness and the deepest furrow in the knotted brow of agony was smoothed away forever.'"

The next year, 1898, in New Orleans, Doctor Halsted read his paper on "Cancer of the Breast." On the work here described, the modern radical operation is founded.

In 1899, Doctor Keen was president. His address was on "Total Laryngectomy." This year, Dr. H. W. Cushing brought out his right-angled continuous intestinal suture. As a result of the Spanish War there were several papers on military surgery. In a discussion on aseptic surgery, under the lead of our foreign guest, Dr. Theodore Kocher, the use of gloves was advocated, at that time a new thing. How much it has meant in the years that have followed for the safety both of patient and surgeon!

Nineteen hundred saw the first real entrance of the Association into the great field of gastric surgery with Doctor Weir's presidential address on "Perforating Ulcer of the Duodenum." Finney and Richardson also spoke on gastric surgery. William J. Mayo, a promising young surgeon from the Middle West, had had three cases of pyloroplasty and partial gastrectomy for cancer. How much has developed from the small beginning of thirty years ago! At the following meeting the vicious circle after gastroenterostomy was first discussed by Thomas McGraw, of Detroit, the inventor of the McGraw ligature, as you will remember. In 1902, Doctor Finney brought out his method of pyloroplasty. Everyone felt that he would like to have thought of that himself. Dr. W. J. Mayo brought up the subject of complications following gastroenterostomy. In 1903, Von Mickulicz was our guest and his topic was "The Surgery of the Gastrointestinal Tract." Here gastrojejunal ulcer makes its first appearance in our records. Sir Berkeley Moynihan, now Lord Moynihan, who since has contributed often and generously to our meetings, spoke on "The Surgery of Benign Disease of the Stomach."

In 1901, pancreatitis appeared with our foreign guest, Mr. A. W. Mayo Robson, and W. J. Mayo brought out the transverse suture of umbilical hernia. I believe there has not been a single meeting since without some contribution from either "Will" or "Charlie" or some other of the many distinguished surgeons of the Mayo Clinic.

At Albany, in 1902, the meeting was noteworthy for a symposium on "The Teaching of Surgery," at which Dr. Herbert L. Burrell introduced for the first time the subject of case teaching. This was an adaptation of a method employed at the Harvard Law School in the teaching of Law. It was introduced at the Harvard Medical School by Doctors Walter B. Cannon

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and John Bapst Blake. Doctor Rixford reported two cases of exophthalmic goitre, the first mention of the subject in the Transactions, and Matas brought out his radical cure of aneurism by endoaneurismorrhaphy.

Dr. M. H. Richardson was president, in 1903, and addressed the Society on the "Contributions of Surgery to Internal Medicine," in which he paid a remarkable tribute to Dr. John Homans. Coley reported the results of Bassini's operation in a thousand cases.

In 1904, Dr. C. H. Mayo appears with a "Report of Fifty Cases of Thyroidectomy in Exophthalmic Goitre." Since then several operations for this disease have been added to the list of his clinic. The first paper on Cystoscopy and Urethral Catheterization was read by A. T. Cabot.

In 1905, Professor Trendelenberg was our guest. Mr. C. W. Ballance, of London, read on "Experiences in Intracranial Surgery." Among other things, he said, "Cases of brain tumor requiring surgical relief are numerous and widely distributed, but those who operate on them, especially on brain tumors, are few and far between."

In 1909, Geo. W. Crile introduced for the first time in surgical history blood transfusion as a practical life-saving method. Is not this something for our Society and for American Surgery to be proud of? Think of the lives it has saved both in peace and under the difficulties of the Great War!

At Denver, in 1911, Doctor Mayo reported end-results in one thousand cases of ulcer of the stomach. Doctor Crile presented "Anoci Association" and Doctor Cushing "Control of Hemorrhage in Operations for Tumor of the Brain."

The operative treatment of fractures was beginning to come to the front and Dr. Edward Martin opened a symposium on that subject. Diverticulitis appeared for the first time. This was at Montreal and Doctor Gerster presided. The papers were by W. J. Mayo and G. E. Brewer. Dr. Charles H. Peck presented "Intratracheal Anæsthesia."

In 1913, came Francis T. Stewart with five cases of suture of the heart.

In 1914, under the presidency of W. J. Mayo, Brewer and Cole read a paper on "Lesions of the Stomach and Duodenum." With Lilienthal on "Pulmonary Abscess and Bronchiectasis," thoracic surgery began to come into its own.

In 1915, the symposium was on the surgery of the spleen.

In 1917, Dr. Samuel J. Mixter presided and made a most important address on the surgical problems of the war. The symposium was on the surgery of the large intestine. As was natural, during these years the surgery of the Great War took up most of the attention of this Society.

In 1919, Doctor Pilcher's presidential address was on the subject of "The Influence of War Surgery on Civil Practice."

Our guest this year was the great Belgian surgeon, dePage, who spoke on "General Considerations in the Treatment of War Wounds." The importance and extent of Doctor dePage's war service and the recent death

of Mrs. dePage in the *Lusitania* lent a tragic interest to his appearance before the Society.

In 1920, Brewer's presidential address detailed the service of the Society during the war, a service in which we may well take pride. Eighty-three per cent. of the fellows volunteered for the war, or ninety-six in all; fifty-seven served in France, forty-eight in this country, and eleven in the French and British armies. The work of Joseph A. Blake at Neuilly and of Brewer himself and our many surgical consultants and operators at the front—Pool, Gibbon, Jopson and many others—redounded to the honor of themselves and the Association. Our fellows received twenty-two decorations and ten citations. We had a brigadier-general, Dr. Finney, whom we all delight to honor. His official family, in 1918, consisted of Majors Peck, Fisher, Harte and J. L. Yates. We had twenty-five colonels, thirty-seven lieutenant-colonels, thirty-one majors, seven captains, and four first lieutenants. The address, based on the experiences of the late war, dealt with the best method for the army to avail itself of civilian surgeons in war.

The venerable Doctor Keen wore the uniform of a major. This was the fourth war in which he had served his country in the ranks. Many of the older men past the age limit were allowed by special dispensation to enter active service, and those still older, like Doctor Keen and many others, served on the draft boards with interest and efficiency, or made invaluable consultants in the office of the Surgeon-General. While we as a Society are proud of our war work, to our members as individuals the memory of their gallant service for their country in France will be a source of pride and satisfaction as long as life shall last. Of the last ten years since the war, which is fresh in the memories of most of us, I shall mention but a few of the more important contributions: Doctor McArthur's presidential address on "Repair of the Common Duct"; Doctor Crile on "The Bipolar Theory of the Nature of Cancer"; and Dr. Harvey Cushing's presidential address on "Orbito-ethmoidal Osteomata." Thoracic Surgery has not been neglected since Lilienthal, Willy Meyer and others have made notable contributions to this subject. Dr. Elliott C. Cutler contributed for the first time in surgical history a report on "Surgical Treatment of Valvular Disease of the Heart."

It has been generally admitted, said Henry Rogers, in a commencement oration on the fiftieth anniversary of his graduation, that the first seventy-five years of a man's life are among his best years. Not so of our Society, which, at fifty years, has just begun to live. It has been true to the ideals of that remarkable man, its founder, through fifty years of unexampled change, during which our art has progressed with a rapidity that takes away the breath of the conservative. In non-professional fields, men have learned to fly (witness the North Pole and the South); with the human voice to put a girdle around the earth in a split second, and that without a wire to conduct the message; by talking motion pictures to preserve forever not only the features and form, but the speech and motions of men. So in surgery in this fifty years have come the wonders of radiation, direct examination of the urinary tract

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by cystoscopy and pyelography, of the intestinal tract by the opaque meal, of the gall-bladder by the brilliant functional test of Graham, a member of our Society, and transfusion, which was for the first time in history made practicable by one of our own members. As the progress of science in physics, chemistry and electricity has been in these fifty years unprecedented, so our profession has been on the alert to avail itself of every step in advance, and to apply it in practice to diagnosis and therapeutics. So that it must be acknowledged as true that the marvelous advance in our art has only been made possible by the progress in general science.

It is an interesting thought that within these fifty years the American Surgical Association has taken part in a surgical renaissance. And a renaissance in surgery, which has been defined (inadequately) as the mechanical department of therapeutics, always corresponds with a renaissance in medicine and science.

The first great renaissance in surgery, of which we have written records, took place in the fifth century B.C., when the school of Hippocrates, at the time of the great flowering of art and letters in Greece, during the so-called age of Pericles, brought our art to a state of development that had to last it for two thousand years.

The second renaissance, which is known as *the* renaissance came in the fifteenth century with a revival of the Greek learning which had been kept alive by the Arabs during the dark ages, and soon, under Vesalius, Harvey, Malpighi, Paré and others, aided by the discovery of the microscope, a steady and remarkable progress began, which was limited, however, by the absence of anæsthesia. With the discovery in 1848 of ether and chloroform, a new era began, and the suffering from surgical operations was eliminated, but the very fact that the amount of surgery was enormously increased crowded the hospitals with septicæmia and pyæmia. A horrible death might follow the simplest operation. Conditions were such that it is hard for us who live under modern conditions to realize what our predecessors must have gone through.

Then came Pasteur, Lister, antisepsis and asepsis, and about this time our Association was founded. Under these conditions a third renaissance began, and is still in progress. Those of us who have striven to keep up with it for forty years realize how rapid it has been. The pace has steadily accelerated. The reason for the rapidity and extent of this progress is the coincident advance in knowledge of science, chemistry, physiology, electricity, and so on, which are now taking place. I have tried inadequately to sketch in a few words the part played in this progress by our Association and its members. Much work and many names of those who have deserved well of their fellows and of our art will be left out, but that the limitations of time make necessary.

In science, radium has revolutionized the atomic theory so that something like the transmutation of metals does take place, and in medicine, radium wonderful to relate, has both produced and destroyed cancer.

The electric cautery knife has extended the field and saves the time of the operator on the brain and on cancer, to the great benefit of the patient. Ultra-violet rays, lipiodol injections, the delineation of the ventricles of the brain by X-ray and air injections are among the diagnostic aids which science has provided. Infections of the most formidable kind have yielded to the Carrell Dakin treatment, the discovery of a member of our Society. By this, during the Great War, thousands of lives and limbs were saved.

Surgical technic we have so improved that the mortality of operations for exophthalmic goitre, taking all cases as they come, has fallen in many clinics to a small fraction of one per cent. The formidable procedure of resection of the stomach carries with it a comparatively low mortality, and in operations for trifacial neuralgia, resection of the sensory root, hundreds of operations have been performed with no mortality at all. The surgery of cerebral tumors has been advanced to a position far ahead of anything ever done before, and the leader in this work has been Harvey Cushing, a member and former president of our Association. Dr. Charles Frasier, of this city, another member of our Society, has contributed much also in this department of our art. For tuberculosis of the bones and joints, the perfection of modern apparatus for artificial heliotherapy has accomplished wonders, because the substitute sun, so to speak, is able to function indoors during the storms of winter.

Other important matters to be found in our Transactions are the work of Bloodgood, on Breast Tumors and the Pathology of Bone Tumors; of Codman on Bone Sarcoma; Porter on Skin Grafting in X-ray burns, and a long list of contributions by other members, many of them perhaps fully as important as those which have been mentioned. In the choice of subjects for mention I have attempted to illustrate the gradual invasion of new fields during the years under discussion, and, in particular, the first appearance of each subject in the *ANNALS* of the Society. The work of Dr. Rudolph Matas, our surgeon and scholar, who for many years has contributed so largely to our knowledge of the surgery of the blood-vessels, should not be forgotten. But how can I bring you all in? The appreciation of your work I have to the full, but time and space forbid.

During the last twenty years the surgery of the spleen has thrown much light on many diseases of the blood system, so that we are gradually learning when the spleen ought and when it ought not to be removed. The operations of splenectomy and transfusion in pernicious anæmia, however, are no longer necessary because the liver feeding of Minot and Murphy has proved so successful. It would seem true of medicine as well as surgery that the future is without limit. Adson, of the Mayo Clinic, and others have presented to us the results of advanced work on the sympathetic nervous system.

The improvements in anæsthesia have, especially in the last ten years, contributed enormously to increase the safety of our work. Ether and chloroform by inhalation, the old stand-bys, once the object of many a controversy as to which was better, have given way to nitrous oxide, ethylene, local,

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regional and spinal anaesthesia, with their various combinations and sequences, not to mention anaesthesia by the barbituric acid compounds. Spinal anaesthesia alone has a tremendously complicated technic, on which volumes have been written, and is a field large enough to keep any man busy. There is tremendous activity at the present time in this field. The profession of anaesthetist has become an honorable and important one. A result is that by the adaptation of the method of anaesthesia to the needs of the particular patient, shock has been diminished, difficult and complicated operations made safe and easy, and the mortality greatly lessened. Consultations between the surgeon and anaesthetist and intimate knowledge of the work of each on the part of the other have contributed to this result.

Compare the operating room of today with its glass and shiny metal, its smooth walls and floor, its shadowless lighting, with the crowded and often dusty theatres in which the founders of our Society did their work. If we could look forward fifty years, would we see as great a change in conditions? It is hard to believe, but by no means impossible. When we think of the immense benefit to humanity which has resulted from all this progress, we are thankful for it and for the part in it taken by our own members. And yet the change is confined to the externals of our profession, the heart and brain within, the courage, the kindness, the observation, the intelligence, were the same in our founders that they are in ourselves. Perhaps they are entitled to the greater credit because they accomplished so much under such difficult and discouraging conditions. But however that may be, we have the benefit of all these refinements. For this we ought to be thankful and endeavor to contribute our own share to the advancement of our art. We know more than our fathers; our sons know more than we. How much modern blood chemistry and biophysics mean, not only to medicine, but to surgery! Insulin and the careful work of Joslin and others in the treatment of diabetes have enormously reduced the mortality of the surgery of this disease. Chemical and physiological investigations have here gone hand in hand with refinements of technic. In the prophetic words of Doctor Cheever, as true now as they were forty years ago, "the future of surgery is without limit."

During the fifty years' life of our Association, other surgical societies have come into existence, such as the Society of Clinical Surgery, and like small associations for clinical study and travel. These societies, in which many of our own members have been active, have served a most useful purpose, but our Society has remained, in the words of its founder, "the altar on which our best contributions are laid." Clinical societies have done much in fostering the spirit of travel and observation, which has been so important in this country, and, among other things, has cemented most lasting friendships between surgeons living at great distances. The conquering of time and space has made travel easy, and much of the time of any progressive surgeon is devoted to travel both in this country and abroad. As I write, the Lindberghs have flown from California to New York in fourteen hours.

It may be common before long to hop over from California to New York for a consultation.

During the past thirty years the great private clinics have been established in this country, beginning with the Mayos', which proved so well its efficiency that similar organizations have sprung up all over the country. Loose associations for mutual help in practice we have always had, but these clinics have done much to make the service efficient and economical for the patient. The parent of them all has now grown into an educational institution, a foundation, with degrees, diplomas and everything complete. It is a Mecca for surgeons from all over the world, and its influence for good on surgical science and practice has been invaluable. We believe it is only on the threshold of its career.

In his presidential address seventeen years ago, Dr. Charles A. Powers asked the question, "Have we a distinctive school of surgery in this country?" He concludes that we have, especially in the sense of breadth of view and of catholicism, in consideration of the best interests of the patient, attention to anaesthesia, and everything which conduces to the patient's comfort and welfare. What was true then is still more true today. Surgery attracts the best of our young men, men with high ideals and noble purposes. The quality of those entering our profession improves from year to year.

The officers of this Association, the secretaries, treasurers and council have attended faithfully to their duties and devised from time to time changes in the constitution and by-laws, which have been always carefully and judiciously considered. This has been a labor of love, but the manner of its performance has enabled our Society to continue its high standards through these fifty years.

During the life of our Association medical education in our country has been enormously benefited by the closing of large numbers of inadequate and unethical schools and by the improvement and expansion of the better schools, which are really the only ones left.

This beneficent work has been done by the Committee on Education of the American Medical Association, but the leading spirit in this work, the chairman of the committee for years, the first-class fighting man, who put it across, was Dr. Arthur Dean Bevan, an honored member of our Association. This suppression of the inadequate schools has been attended by an enormous improvement in the schools that have survived. Endowments have flowed freely to the better schools, professors are called from one school to another, and every effort is made to secure the very best men for the professional positions.

During these fifty years, many eminent European surgeons, besides those whom we have mentioned, have honored us by their presence and been elected honorary members of our Association. Among them are Bastianelli, Sir Anthony Bowlby, Chutro, Hartmann, Leriche, Lorthioir, Sir George Makins, DeMartel, Sir Thomas Myles, Sir D'Arcy Power, Sir Harold Stiles, Sir Cuthbert Wallace, Charles Walther, and others. The debt of our Society

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to these men and others across the water who have come to our meetings and given us of their work is very great. In the youth of some of us older members, we went abroad to study. Many of our very best surgeons are indebted to foreign travel in their youth for the benefits conferred by laboratory study at first hand under the great masters of that day, from whom they learned not only technic, but a thorough training in the spirit and methods of scientific investigation. But once a surgeon, always a student. Now, though it may not be as necessary as of old to go abroad for preliminary training, the benefits which we have had and probably shall get from visits to European clinics can hardly be exaggerated. From continental Europe in the early days came some of our own members, whose knowledge of physiology and pathology helped us in our many difficulties—men such as Christian Fenger, in Chicago, and Gerster, in New York. It has been fortunate for us, too, that Canada, for the purposes of our Society, has not been a foreign country. The communications of some of our Canadian members, witness, for instance, Archibald on Thoracic Surgery, could hardly have been spared from our meetings.

It is a beautiful Greek legend that made Philosophy the daughter of Wonder. We wonder what the reasons for what we see are and try to find them out. *Felix qui potuit rerum cognoscere causas.* "Happy the man who knows the reasons for things." Modern science, having first transformed the atom, which forms the basis of matter, into a little universe of electrons an immense distance apart, has now transformed it again into vibrations of a hypothetical ether. Surely matter has become something very like spirit. Our stout old Hebrew God didn't do anything so wonderful when he made the earth out of nothing. It is made out of nothing, at least nothing that we can understand. God becomes like the poet who gave to airy nothings "a local habitation and a name." "And when the lofty towers, the gorgeous palaces, the solemn temples, the great globe itself, aye, all that it inherit, shall dissolve, and, like this unsubstantial pageant faded, leave not a wrack behind," there will still be left something very like the spirit of God moving over the waters or at least over the ether, whatever that is. So much for philosophy.

A member of our Association must be a surgeon, teacher and lover of mankind, according to our constitution. May we and those who follow work as hard as did our predecessors in *rerum causas cognoscendo*; may our love for mankind and of our art go on from strength to strength. If so, the record of our beloved Association in the future will surpass even its proud record in the past.

EXPERIENCES WITH THE TRENDELENBURG OPERATION FOR PULMONARY EMBOLISM

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AT THE German Surgical Congress of 1908, Trendelenburg reported his experimental research on embolectomy of the pulmonary artery, and at the same time described the first two operations for pulmonary embolism in man. One of these, performed by his assistant, Sievers, succeeded in so far that the patient survived the operation for fifteen hours; shortly afterward, another patient operated upon personally by him survived for thirty-seven hours.

Since Trendelenburg's report, some thirty operations for pulmonary embolism have been published or briefly mentioned in the literature. It is probable, however, that the number of such operations which, because they have been unsuccessful, have been regarded as not meriting publication, is far greater.

The cases where the patient has survived the operation, so far as I have been able to find, are the following:

<i>Operator</i>	<i>Year</i>	<i>Survived Operation for</i>
Sievers-Trendelenburg	1908	Fifteen hours
Trendelenburg	1908	Thirty-seven hours
Kruger	1909	Five and one-quarter days
Schumacher-Sauerbruch	1914	Fifty hours
Kirschner, Königsberg	1924	Discharged healed
Meyer, Charlottenburg	1927	Discharged healed
Crafoord, Morby Hospital, Sweden Dir. Dr. Giertz	1927	Discharged healed
Nystrom, University Hospi- tal Uppsala, Sweden	1927	Thirty hours
Nystrom, Uppsala, Sweden	1927	Five hours
Nystrom, Uppsala, Sweden	1928	Discharged healed
Meyer, Charlottenburg	1928	Discharged healed
Nystrom,* Uppsala, Sweden	1929	Three hours
Nystrom, Uppsala, Sweden	1929	Discharged healed

* Wrong diagnosis, uræmia.

It is desirable that in the future, not only the successful, but also the unsuccessful cases of Trendelenburg's operation be carefully described and published, as there is need of larger empiric material, both for fixing the indications for the operation, and for perfecting its technic.

In fatal cases of pulmonary embolism, death frequently ensues immediately, or within a few minutes, but in most cases only after more than five minutes have elapsed, and in about half the cases, according to the data collected from various sources, more than ten minutes after the onset

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of the attack. Not infrequently it is only by repeated embolisms in the course of several hours or days that complete obstruction is reached which takes the life of the patient.

It is generally held that in those cases where the embolic catastrophe is instantaneously fatal, it is hopeless, even with the best organization, to attempt the operative removal of the obstruction in the pulmonary artery. But it is difficult to say where the line for operability has to be drawn, because, so far, we have not the necessary experience with regard to the length of time during which, under different conditions, the pulmonary artery can remain obstructed before the interruption of the circulation is sufficient to be fatal.

In experiments upon rabbits, Laewen and Sievers found that obstruction would cause death if lasting more than two and one-half minutes. But by the aid of different kinds of resuscitative measures, *i. e.*, artificial breathing, with oxygen, injection of adrenalin into the heart, *etc.*, the animals could be revived, even if the obstruction had been prolonged seven to eight minutes.

Trendelenburg states that embolectomy must be performed within forty-five seconds after obstruction of the pulmonary artery has occurred, and this rule seems to have been generally accepted. However, in Crafoord's case (No. II) the obstruction lasted sixty-one seconds, and in my five surviving cases, sixty, sixty-five, one hundred and four, seventy-five and one hundred and five seconds intervened before the obstruction was relieved. To these periods of mechanical obstruction must be added the ten seconds before the heart resumed sufficient action. Consequently, it would seem that under favorable conditions a complete suspension of the circulation for nearly two minutes is not necessarily incompatible with the persistence of life.

One of my latest cases, where the patient died on the table, a satisfactory action of the heart could be started even seven minutes after the patient had ceased to show signs of life, but it was not possible to reestablish respiration.

This last observation seems to indicate that the suspension of the circulation occasions irreparable injuries to the respiratory centre in the medulla oblongata sooner than it does to the heart, and this is confirmed by similar experiences elsewhere. Thus Renzi could make the heart resume its action forty minutes after a Trendelenburg operation, although respiration could not be reestablished in spite of artificial efforts, including the administration of oxygen. In a case of Kirschner's, reported in a personal communication to Meyer, spontaneous respiration was never reestablished, although the heart resumed normal activity and only ceased to beat after a period of two hours of artificial respiration.

The effects of shutting off the blood-stream on the higher centres of the brain have, in the few cases where the observation has been possible, shown considerable variation. The patient operated upon and saved by Kirschner regained consciousness only after four days, and was alternately delirious and comatose during this interval. In Meyer's second case the patient showed great anguish and confusion, and vomited; however, he had

full consciousness nine hours after the operation. Kruger's patient regained consciousness about seven hours after the operation. Crafoord's first case was unconscious for several hours following the operation, cold, clammy, and for the first two days lay in a shock-like condition, at times delirious, and with complete amaurosis. On the third day her sight returned, and after this she had no cerebral symptoms. In this case, the obstruction had lasted but forty to forty-five seconds. However, when the pericardium was opened, the heart showed only an auricular flutter and no real contractions, so that evidently the complete cessation of the circulation had lasted for a longer time.

In Crafoord's second case, the cardiac ventricles at the time of the operation were making weak, irregular contractions when the rubber tube was pulled tight, and in this case the interruption of the circulation lasted for sixty-one seconds. This patient awakened while on the operating table, and showed no signs of cerebral injury during the subsequent convalescence. A similar resumption of the brain function was characterized by Meyer's first and third case and my own fourth case, with a period of obstruction lasting from sixty to one hundred and five seconds. One of my recovered patients, on whom the rubber tube had been kept taut for about two minutes, was able to reply to questions immediately after the operation, saying that he felt well, and proposed to walk back to his ward. Later, however, he had not the slightest memory of the incident from the moment of the onset of the attack till he was again in his bed some time after the operation.

The same interesting observation of complete amnesia after the onset of a severe attack of pulmonary embolism, although the patient may have seemed to be fully competent and actually suffering at that time, was made in my second case and also in cases reported upon by Kirschner and Crafoord. From the observations cited, the impression is gained that the consequences following the blocking of the circulation vary from case to case. This, however, is quite natural if it be kept in mind how many different factors play a part in the process. This disturbance of the circulation, first of all, is conditioned by the degree and duration of the embolic obstruction itself, before the embolectomy, and then by the technical strangulation of the larger vessels, necessary for the intervention, and finally, also by the obstruction of the branches of the pulmonary artery persisting after the completion of the operation. It must be remembered that even a very successful extraction may not lead to a complete cleansing of the vascular channels, while embolic masses frequently are thrust into the circulatory branches of the artery where they are out of reach of the operator. The chances of the restoration of the circulation depend also upon such factors as the age of the patient, the nature of the primary complaint, the degree of cardiac degeneration, adiposity, and the extent of the infarcts, complicating pneumonia, sepsis, *etc.*

In order to estimate the physiological effect of strangulation of the large vessels and the period during which it may last, or may be permitted under different conditions, we must have knowledge of the condition of the patient

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and of the cardiac action and respiration up to the moment when they were stopped by the constriction of the tight rubber tube.

It seems fully justifiable to me to test under such favorable conditions, as a quick intervention, successful extraction of the embolus, and satisfactory physical condition, if it will not be possible to occasionally revive a patient even after he has ceased to show signs of life for several minutes. Given a good organization, it should be possible to have the artery cleared and the blood-current reestablished within six to eight minutes.

As a rule, however, the Trendelenburg operation will be confined to those cases where the pulmonary embolism does not kill immediately, but only within the course of ten minutes, so that the operation can be regulated and planned at the right moment; that is, while the heart action and circulation have not been completely obstructed, although the certain death of the patient is imminent within a few moments.

Evidently it will be difficult always to fix the indications, as everyone with some experience knows that even very threatening conditions of pulmonary embolism may abate, and further, that the operation is so dangerous that it may completely destroy what chance there is of recovery. By limiting the indications, of course, some cases may be lost which might have been saved by operation, but, nevertheless, it is probably the wisest course to follow a moderate policy in cases of doubtful prognosis, at least until more experience has been obtained. Meanwhile, every opportunity should be developed to make it possible to attempt this operation where there seems to be a chance to accomplish anything by surgical procedure. This means that the patient to be operated upon must be ready for immediate intervention when all other chances seem to have vanished.

One should consider the advisability of completing the first part of the operation, which is time-consuming, and the exposing of the heart under local anaesthesia, which could be done with little danger, provided the wounding of the pleura is avoided, and then await the performing of the embolotomy until, if, and when, this becomes necessary, which will then require but a few minutes.

Another difficulty is that at the present time we have no definite method of diagnosing pulmonary embolism. Giertz writes in his work on thrombo-embolic surgery (*Acta chirurgie scandinavia*): "It is only in rare cases that one need hesitate over the diagnosis and be in danger of operating when embolism is not present." This, however, is contradicted by the experience of others, for mistakes have frequently been made. Thus, in a series collected by Capelle, the clinical diagnosis of pulmonary embolism was found to be wrong in nine cases out of twenty-six, most of these conditions having been mistaken for cardiac insufficiency. Riedel gives two cases from Denk's clinic, where cardiac insufficiency was interpreted as embolism and operation resulted in a fatal termination. I myself have operated upon one patient with uræmia who gave symptoms closely similar to those of pulmonary embolism (Case V). This patient was a man of sixty-nine who had been

admitted for prostatic adenoma and with retention of urine, and who, seven days after vasectomy, without other symptoms of thrombosis than "kletterpuls," suddenly developed an attack of dyspnoea, cyanosis, and feeble pulse, and within a short while was moribund. At the operation no thrombi were found in the pulmonary artery, the patient recovered from the operation but died after three hours in uræmia.

Pulmonary embolism may appear under various forms. The most common symptoms, when death does not ensue at once, are, shortness of breath, anguish, feeble pulse, paleness and cyanosis, and a stitch in the chest. These symptoms, however, may exhibit wide differences, both as to quality and intensity. Consequently, the condition is very changeable. In one of my cases, the most profound symptom was the feeling of constriction, like to that of a girdle around the chest, and this was associated with vomiting. In another case the attack resembled closely an acute syncope due to cardiac insufficiency or anæmia of the brain, and when the patient recovered consciousness he had no shortness of breath or pains, but an irritating cough. Within a couple of minutes the patient collapsed again, and was immediately operated upon. It is of interest to note that the pulse need not be accelerated.

*Anatomical conditions and technical details of importance in the operation.**—Trendelenburg suggested that the operation be performed through an incision which would permit of the removal of the second costal cartilage and adjoining portion of the rib, thus exposing the pericardium through a widely opened left pleural space. The pericardium is incised just in front of the phrenic nerve. Renzi, when operating upon a patient shortly after Trendelenburg's report in 1908, tried to proceed extra-pleurally, but was unsuccessful and made a small hole in the pleura, which was promptly closed with pressure forceps. To Meyer is due the credit for first pointing out, in 1927, the importance of avoiding injury to the pleura and thus avoiding acute pneumothorax. The immediate dangers of pneumothorax, of course, can be reduced if the operation is done under positive intra-pleural pressure, but such pressure interferes with the pulmonary circulation. The risk of pleural infection, as shown by Kruger's first and very promising case, will be added to the already sufficiently numerous dangers. It would seem Meyer is entirely right in insisting so strongly for an operation without the opening of the pleura. The operation may succeed if the pleural cavity is opened, as has been proved by Kirschner's case in 1924, who was operated upon after the method of Trendelenburg, and my two successful cases, in which a pneumothorax resulted after lesions of the pleura. Meyer also, it seems to me, is underestimating the difficulties of avoiding injury to the pleura.

The costomediastinal sinuses of the pleura vary considerably as to position. The right one may reach far beyond the left edge of the sternum, and the left one be near the right side of the same bone. If, in order to avoid

* Beir, Braun and Kummell: Oper. lehrb. 4-5, Auf. Abt. 2, p. 584, Fig. 508.

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a lesion of the left pleura,* one approaches too close to the sternal edge, or even under the edge, there is a risk of opening the right pleura, which happened in one of the cases operated upon by me (Case X).

In the region where we wish to open the pericardium, below the second and third costal cartilages, the lines of reflection of the pleural sack are covered by rather firm and fatty fascia endothoracica, which are really the anterior coverings of the bed of the thymus gland, and sometimes they are separated in this place by considerable portion of the thymus itself. In one of my successful cases it was necessary to cut the thymus away from the pericardium with scissors in order to make the pericardium accessible for deliberate incision.

As a rule, it is not possible, immediately after removal of the second and third costal cartilages, to recognize the pleural sinus; one has to expose it by blunt dissection. This entails a risk of rupture of the pleura, which in this region is very like thin tissue paper. Below the second and third costal cartilage it may be so thin and fragile that the cartilage can be isolated and cut only by exceedingly careful division. In sections of old and lean individuals I have also seen the pleural sinus at a depth of several centimetres, its walls lying close to each other, the pleural lamina forming a paper-thin translucent membrane between the two pleural cavities (Fig. 1). The finding of the dividing line between these pleural sinuses and the blunt separation of them to expose the pericardial sac without opening one or the other of the pleural cavities may be a very delicate task. In other cases, however, the thickness and resistance of the pleural lamina and the occurrence of abundant, loose, parapleural and interpleural connective fatty tissue, together with a comparatively wide space between the two pleural sinuses serves to make the task easier.

The free portion of the pericardium, in the immediate neighborhood of the chest wall, will, however, be found below the fourth and fifth costal cartilages on the left side. The lines of reflection of the pleura at this point can be more easily distinguished than higher up, as they are not hidden by the coverings of the thymus gland, which as a rule does not reach this far down. I have suggested, in a paper read at the German Congress of Surgery, 1929, that this anatomical condition should be made use of in the operation for pulmonary embolism by the following modifications of Trendelenburg's method of uncovering the pericardium.

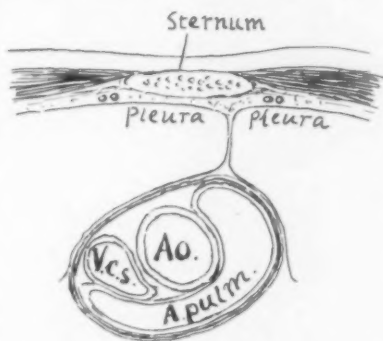


FIG. 1.—Schematic cross section of the chest wall and the anterior mediastinum. Chest wall, anterior mediastinum, pericardium and large vessels at the level of the third costal cartilage. Condition may be found in old and lean individuals.

* Kruger's patient, 1909, survived the operation for five and one-quarter days, but died as a result of infection of the left pleural cavity.

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Trendelenburg's combined incision is not necessary. Good access can be gained through a longitudinal incision along the left edge of the sternum,

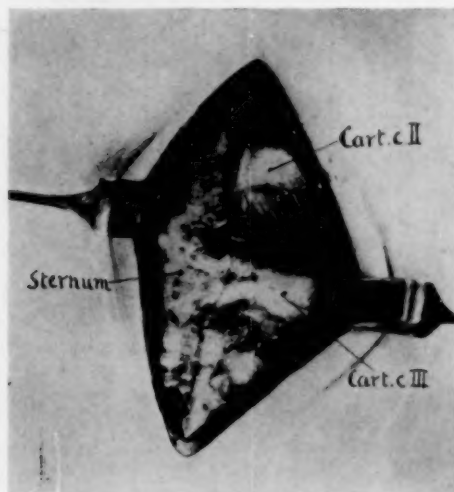


FIG. 2.—Longitudinal incision for the Trendelenburg operation.

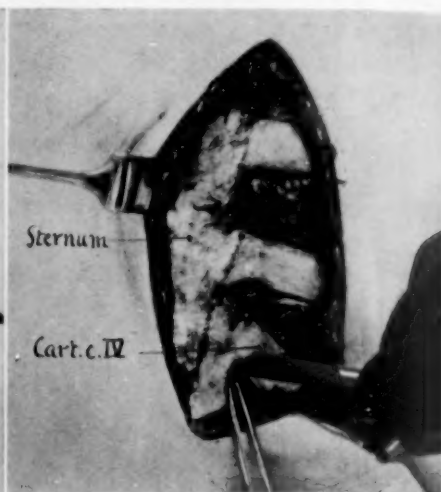


FIG. 3.—Costal cartilages freed of musculature.

extending from the upper edge of the second to the lower edge of the fourth costal cartilages (Fig. 2). The intercostal muscles attached to these cartilages are divided with the scalpel (Fig. 3) and the cartilages with the adjacent

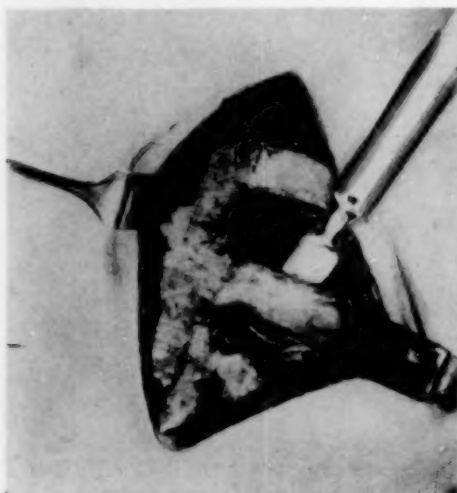


FIG. 4.—Costal cartilages and adjacent portions of the ribs isolated with periosteal elevator.

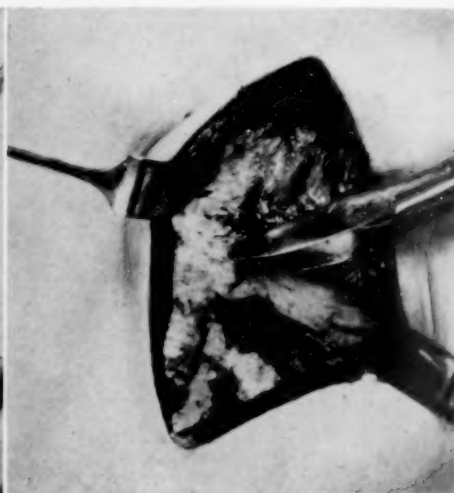


FIG. 5.—Costal cartilages cut at the sternum.

parts of the second and third ribs are then isolated subperiosteally (Fig. 4) with a raspatorium. This requires extreme care because of the risk of opening the pleural cavity. The cartilages are cut as close to the sternum as possible, even to the excision of angular portions of the edge of the

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sternum, and this should include the adjacent isolated portions of the ribs (Fig. 5). The internal mammary vessels can now be seen along the edge

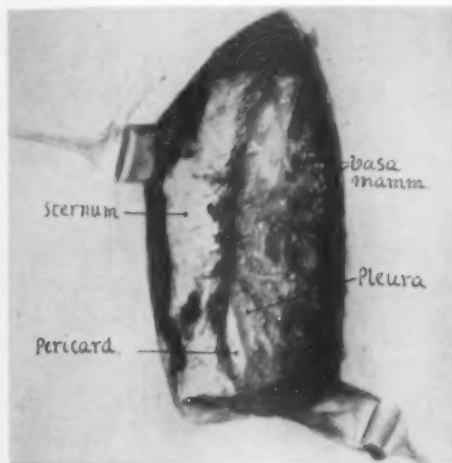


FIG. 6.—Rib resection performed. Mammmary vessels exposed. Reflection line of the left pleura and the free surface of the pericardium are seen in the lower portion of the wound.



FIG. 7.—Pleura pushed aside with a sweep of the finger.

of the sternum and may not need ligation. In the lower medial corner of the wound, where the fourth costal cartilage has been removed, the free surface of the pericardium can be visualized (Fig. 6). Here the finger is



FIG. 8.—Tougher strands of connective tissue over the superficial part of the pleural sinus cut with scissors.



FIG. 9.—The pericardium widely exposed.

entered and moved upward in the loose tissue between the pleuræ. Frequently it is possible to move the left pleural sinus aside with one sweep of the finger (Fig. 7), but at times superficial, firm streaks of connective tissue have to be cut through with scissors (Fig. 8), while the pleura is protected

with the finger. The mammary vessels accompany the pleura. The pericardium is now sufficiently exposed (Fig. 9) and is incised in a longitudinal direction and the flaps seized with forceps (Fig. 10). It must be remembered that the pleura may be damaged also during the latter stage of the operation, as happened to Meyer in one case, and as has also happened to myself. The slipping of a retractor may be the cause of rupture of the fragile pleura. It, therefore, seems to me to be wise to fasten the flaps of the pericardium to the skin, or to cover the wound on both sides with gauze and to fasten the flaps of the pericardium to these pads with artery forceps or special forceps for that purpose, *e. g.*, the so-called Mikulicz forceps.

With these modifications, the operation is then carried out as suggested by Trendelenburg (Fig. 11). For the application of the rubber tube designed to constrict the large vessels, I have found that Trendelenburg's instru-



FIG. 10.—The pericardium is opened.



FIG. 11.—The Trendelenburg probe is carried around the big vessels, through the sinus pericardii. The coupling of the rubber tube to it is about to be made.

ment serves its purpose well, but I agree with Meyer's suggestion that another instrument with a curve of somewhat shorter radius should be available. I have modified Meyer's instrument by shortening the shank 1.5 centimetres.* The fact that the coupling in the original Trendelenburg probe is unsafe is its most serious defect. Kirschner, one of my assistants, and myself have had this coupling come undone because the rubber tube was twisted while being carried beneath the vessel, so that the bayonet catch was released. I have, therefore, had a probe constructed with a catch which will allow instantaneous coupling, besides safeguarding against the danger of detaching the tube during the operation. The rubber tube, of course, need not be released from the probe when it has once been applied; the probe can be

* The instrument with these modifications may be obtained from Stille-Werner, of Stockholm.

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placed beside the wound, and the tube unscrewed when the operation is completed.

The rubber tube should not be pulled tight until a moment after the vessel has been opened in order to allow the emboli that may be in the heart to enter the artery. If the heart has already stopped beating, or is moving only very feebly, the tightening of this rubber tube need not be strong. On the other hand, a fairly powerful pull may be necessary if the heart is still working with any force.

Too strong pressure with the rubber tube, however, may be dangerous. In one of Trendelenburg's own cases and in one operated upon by Sauerbruch, and described by Schumacher, a rupture occurred on the posterior portion of the artery and what chances there might have been of saving the patient were naturally destroyed in this way. In one of my earlier cases a rupture of the artery was undoubtedly caused by drawing the tube unnecessarily tight, but in this case the rupture was confined to the intima (Fig. 12). From these ruptures, however, a fresh wall thrombus had developed, extending into the bifurcation of the artery, and causing partial obstruction of the main branches, thus possibly contributing to the fatal issue which supervened after thirty hours.



FIG. 12.—Ruptures of the intima of the pulmonary artery (R.) and the thrombus (Th.) that developed from them.

In contrast to this condition developing from the rupture of the vessel wall, the place of the suture itself was quite free from thrombus formation.

A similar observation has been made by others, where the patient has survived a sufficient length of time for the thrombus to develop. This is in contradistinction to the course in embolectomies upon the arteries of the extremities, where there is a tendency for the thrombus to develop at the site of the suture when the intima has been damaged, or where there is an associated arteriosclerosis.

If one is not closely acquainted with the anatomy of the large vessels issuing from the heart, it may happen that the aorta is opened in mistake for the pulmonary artery. In their first attempt this has happened with several surgeons, Schmidt, Capelle, one of my assistants and myself, and one other Swedish surgeon. Therefore, it is of the greatest importance to acquire a good orientation in the topographical anatomy of the large vessels by means of practice on dead bodies.

As a rule it is easy to find the right branch of the pulmonary artery, as

it passes across the operative wound in the direction of the right axilla. The left branch occasionally gives more trouble. It bends directly backward from the end of the short main stem of the artery and when the patient is in a lying position its direction is straight downward. If the incision in the artery is placed too close to the heart there is a risk of one being unable to make the extracting instrument "turn the corner" into the left branch, as happened in one of my cases. If, on the other hand, incision is made too far away from the heart, it may happen, as in another of my cases, that the extracting instrument rides past the opening of the left branch, missing it because it is too close to the incision. This happened in one of Trendelenburg's cases.

It is, of course, of the greatest importance to quickly find the way into



FIG. 13.—(Con. a.) The pulmonary artery (A.p.) and its right (R) and left (L) branches. (vv) vales of the ostium at the root of the pulmonary artery. The proper place for the incision in the artery is marked with a black line. A needle is inserted in calf vertically in the recumbent position of the body. The pulmonary artery is seen from above and in the position one sees it in the operation. The head of the needle is seen just beneath (A.p.).



FIG. 14.—The artery seen from the cephal side.

the left main branch, so that the evacuation of the emboli can be done in the shortest possible time. I have reproduced a few pictures of stearin casts of the pulmonary artery in the position it occupies in an individual lying on his back (Figs. 13, 14 and 15). In this position the needle has been stuck vertically into the main stem of the artery, so as to allow an accurate reconstruction of the position of the artery when the cast has been removed.*

* The cast had been made by injecting melted stearin into the right ventricle from a small opening in the chest wall, from which small parts of the cartilages of the third and fourth ribs and the neighboring parts of the sternum have been removed. Naturally, the casts obtained are incomplete, as a result of the presence of blood coagulating in the artery, but nevertheless give a good picture of the typography of the artery. In the casts here reproduced, the defects are filled out with plaster, which is seen as a slight band in Fig. 13.

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For the extraction of the emboli the Trendelenburg instrument (Fig. 16) on the whole serves very well. It is excellently adapted for the right branch, while for the left branch a somewhat more curved instrument would be easier to insert. Such a modification, as a matter of fact, has been suggested by Schumacker, but it has, on the other hand, been pointed out that a change of instrument would complicate the operation and might entail loss of valuable time.

Frequently the emboli are so solid that it is possible for the extraction forceps to obtain a firm hold upon them, but it is not uncommon for the embolic masses to be so fresh and loose that they offer no resistance to the forceps and, consequently, cannot be recognized. The search in such cases

has to be a blind one. The soft consistency of the emboli may also lead to their fragmentation when they are grasped by the forceps. Further, the forceps can reach the thrombi only in the stem and main branches of the artery, as space is required to open the limbs of the forceps. Probably

it is through these circumstances that in many of the published operations for pulmonary embolism, great embolic masses have remained and have probably contributed to the unfortunate issue. In my Case III, the emboli were so soft that it was impossible to feel them with the forceps, and, as it happened, a large clot was left in the left branch. In this case death ensued rather suddenly, five hours after operation.

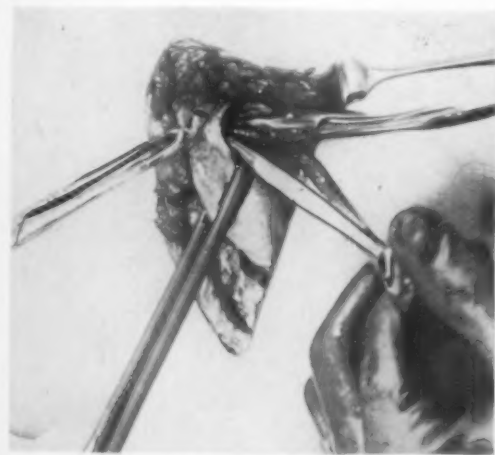


FIG. 16.—Extraction of an embolus with the Trendelenburg forceps.

The post-mortem revealed a clot which reached from the left branch into the stem and obstructed the right branch as well (Fig. 17). It is possible that it had enlarged in the direction of the heart by secondary thrombosis, or that another thrombus had lodged in front of the old one, thus suddenly making the block complete. In this particular case, however,



FIG. 15.—The artery seen from the left side. Note the bending of the left branch inferiorly (in the upright position posteriorly) and even a little caudal.

the ultimate cause of death seems to have been a beginning pneumonia, which was evident at post-mortem.

These inherent difficulties of the extracting forceps forced me to experi-

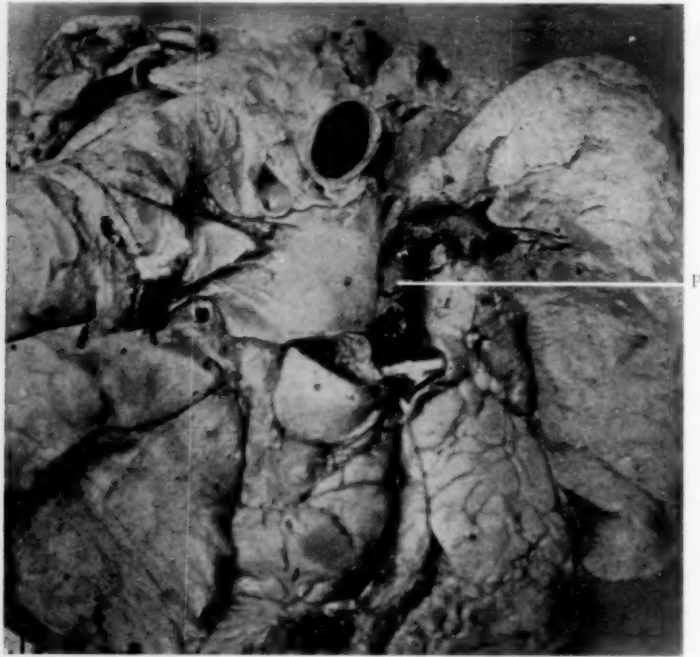


FIG. 17.—Embolus in the left branch of the pulmonary artery remaining after incomplete extraction.

ment with a suction apparatus. The idea is not new. Trendelenburg himself in some of his experiments upon animals tried to extract the clot with a suction syringe and a wide canula, but considered the method unreliable

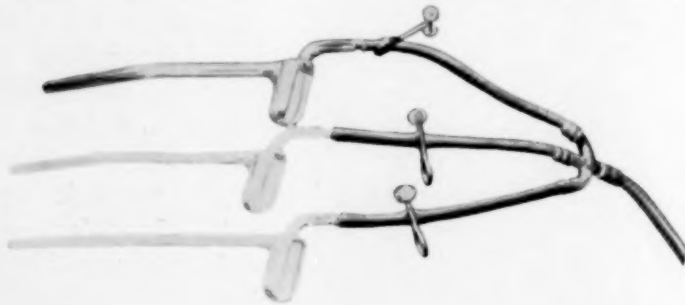


FIG. 18.—Suction apparatus.

and involving a risk of traumatizing the intima and, therefore, preferred the extraction with forceps. However, I argue that it would be easier to grasp even very loose and brittle emboli with a suction apparatus and that it would make possible the extraction of emboli from the peripheral parts of the arterial tree that would be inaccessible to forceps. It would be necessary,

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however, that such a suction be very gentle, more so than would be possible with a syringe.

Fig. 18 shows the apparatus I have used. It consists of three pipes, each connected to a reliable water air pump by short rubber tubes, a tripartite glass tube and a common longer rubber tube. The pipes are furnished with a reservoir designed to keep the blood clots from passing the pipe, which might close the tubes. Two of the pipes are kept closed as a reserve in case the one should be put out of function by being stopped up.

In the first of my successful cases, this apparatus did very good service (Fig. 19). The forceps had first been inserted but only a few clots could be extracted with them. The suction pipe, which was then inserted, at once caught an embolus, which was thicker than and as long as one's thumb,

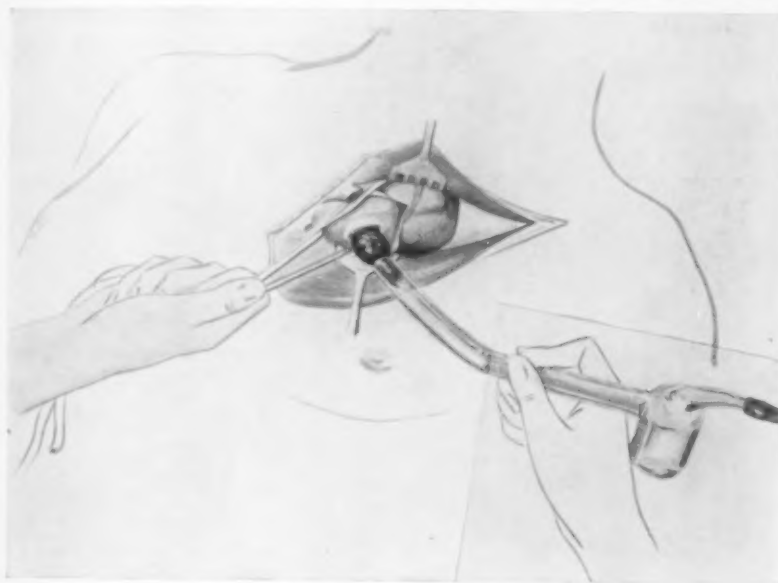


FIG. 19.—Extraction of embolus with suction apparatus.

which was extracted *en masse* (Fig. 20). It was so thick, however, that it lodged when it was half-way out of the incision, so that its delivery had to be completed with the forceps. The forceps and the suction pipe were then used alternately, but only one or two additional small emboli were found.

It has, of course, to be considered that when a suction apparatus is employed, not only emboli but also blood is sucked out of the artery, and that the blood is replaced by a large or small amount of air. When the artery has been closed and the blood-current reestablished, it might then happen that the branches of the artery were obstructed by air. Therefore, the artery should be filled with blood by releasing the tourniquet for a moment before the suture is inserted. This procedure may also serve to carry away remains of emboli, which may still be lodged in the artery. In my first successful case I forgot, in my hurry, to take this precaution, although I had decided

upon it beforehand, but, fortunately, no inconvenience seemed to follow this omission.

Trendelenburg's suggestion is that, if it is necessary to perform the extraction in several stages with intermissions in order to allow the blood to pass through the vessel, the incision in the artery may be provisionally closed with the fingers. In experiments with animals it has been shown that repeated constrictions of the large vessels are tolerated quite as well as a single one and there is something attractive in the idea that the blood should be allowed to flow through the vessels as soon as possible. Kruger used this procedure successfully in his case, operated upon in 1909. Meyer also recommends this method, and his work in *Deutsche Zeitschrift für Chirurgie*, 1927, is illustrated by a fine picture. On the other hand, of course, this practice

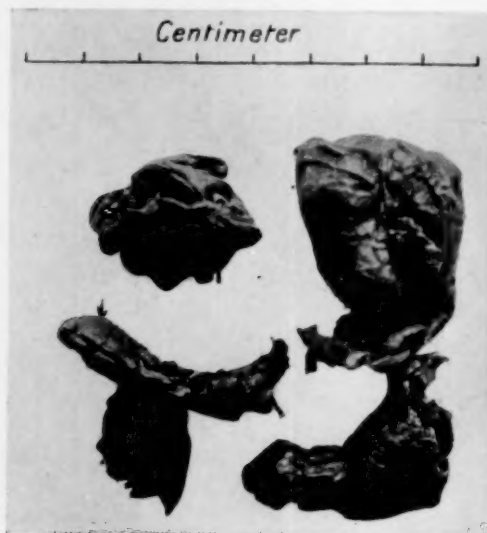


FIG. 20.—The embolic masses removed in Case IV.

may result in fragments of the embolic masses, which would still be within reach of the extracting instrument, to be pressed into the branches of the artery, thus becoming quite inaccessible. If a considerable part of the pulmonary channel is still being blocked, this might be expected to involve difficulties with the heart that would be so great that the advantages gained by permitting a small amount of blood to pass would be more than counteracted by the injury suffered by the heart through protraction of its arrest. In any case the suggestion of suction extraction seems to me to deserve consideration and trial. The decision will depend on further experiences regarding the length of time during which, under different conditions, the large vessels may be blocked without irreparable injury to the heart and the respiratory center.

The rest of the operation is performed as advised by Trendelenburg. Meyer's modification of the forceps used for closing the incision seems to me to be an improvement, as by their aid it is not necessary to close so large a section of the vessel as with the original somewhat clumsy and too sharply bent Trendelenburg forceps (Fig. 21). The release of the rubber tube around the great vessels should perhaps be made slowly, having regard to the experiences of Vroemsten in his experiments on cats, in which he found that quick relief of a constriction of the great vessels, issuing from the heart, may cause immediate death, while a gradual reestablishment of the circulation is tolerated well (Figs. 22 and 23).

✓ When the opening in the artery has been closed and the rubber tube

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FIG. 21.—Application of the Trendelenburg-Meyer artery clamp.



FIG. 22.—Suture of the wound in the pulmonary artery.

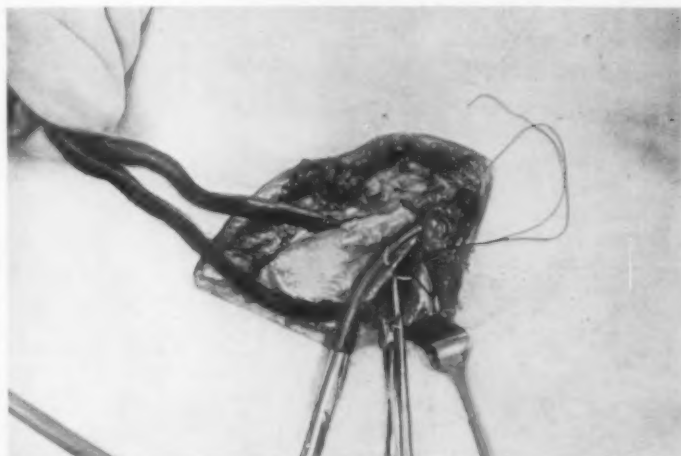
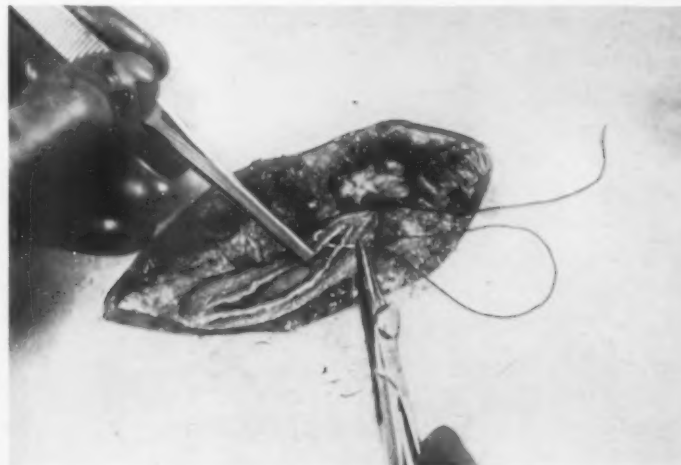


FIG. 23.—Suture of the wound in the pericardium.



released, the next object is to reestablish the action of the heart and respiration, which stop completely when the rubber tube is pulled tight if they have not already been arrested before. If the heart does not start spontaneously, mechanical irritation may first be tried. In one of my cases all that was needed was a slight push with the little finger, upon which the heart responded, at first with contractions that were hesitating and irregular and then with more and more powerful ones. Gentle, pulsating compression between the thumb and two fingers placed behind the heart may also be efficient. Schumacker in one of his cases succeeded in stimulating contractions by pressing the heart against the anterior chest wall.

In one of my latest cases, however, I found that massage may be dangerous. The patient was a fat female, sixty-nine years of age, whose heart would not start again after the extraction of emboli. After the vein was massaged, copious bleeding occurred, which was at first supposed to be caused by an incomplete closure of the incision in the pulmonary artery. Later it was found to arise in the wall of the right ventricle, where a finger had caused a small rupture in the conus arteriosus. The wall was extremely brittle, consisting of a grayish muscular layer about two millimetres in thickness, and the rest was composed entirely of fat. After death, it was found that the cardiac wall was soft and that a finger went through it as though it were made of butter. This patient, of course, should not have been operated upon.

Adrenalin injections have proven to be an excellent means of stimulating cardiac contractions. I made an injection of one centimetre of a 1 to 1000 solution of adrenalin in the bulbous arteriosis in three of my cases, and there was almost instantaneous effect. The heart, which had previously made only irregular movements, began to perform regular contraction which within a few seconds increased to almost violent force. Probably the adrenalin acts first through diffusion into the coronary artery. Crafoord in his two successful cases has also employed injections into the aorta. To me these seem to have the advantage of insuring full knowledge of the manner of the disposal of the adrenalin, and of obviating the risk of lesions to the conducting mechanism. In one of my cases where the injection in the aorta was of no avail, an injection into the heart itself was also useless.

In five of my cases, as in that of Kirschner, respiration was reestablished as soon as the heart resumed regular action. If this should not occur, artificial respiration has to be started with rhythmical insufflation of oxygen, *e.g.*, by putting on and lifting off the mask in which a positive pressure narcosis is made or by means of a pulmotor. The inhalation of carbon dioxide may result in the reestablishment of respiration (Dzial Oszynski). Positive pressure may also be needed if the pleura should have been damaged.

The importance of an efficient organization of the hospital, and particularly of the surgical service, to make possible the performing of an operation with the least possible delay, is self-evident. Clearly, the necessary instruments should always be sterilized. In the Uppsala Clinic the rule is, that if, on

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account of suspected or evident thrombosis and signs of pulmonary obstruction of the lungs in the form of small emboli, a patient can be expected to develop embolism and thrombosis of the pulmonary artery and thus be a subject for operation, everything is put in complete order in the operating room, and the personnel of the staff warned. A transport carriage is placed beneath the patient's bed and the elevator is held at the floor where the patient lies. If the condition becomes more definite, the patient is moved to the operating room and is observed there. If further symptoms set in and the indications develop but are not considered sufficient to demand operation, the watch is continued by the surgeons themselves. Our rule is, not to operate until the patient, as far as it is humanly possible to judge, no longer has any chance of returning to life. It might, however, be worth consideration, as already pointed out, to do the preliminary part of the operation, including the exposure of the pericardium, before the condition has become too serious. The development of events could then be watched, and if the patient's condition continues to progress unfavorably, the operation could be completed, in which case it should be possible to empty the artery. It seems probable that in the future it may prove possible, thus to perform "in advance" under a local anaesthetic, the preparatory rib resection which, of course, requires particular care and adequate time to avoid injury to the pleura and the establishment of a pneumothorax. In this way it may be possible to call to life an occasional patient who has ceased to show signs of life for one or two minutes. Of the ten cases of Trendelenburg's operation from the Uppsala Clinic, I have myself operated upon eight, and this has been made possible by my having practically all my work within the hospital, and by living also within its grounds.

In the after-treatment there is frequently much to cause anxiety. Some of my patients who survived the intervention died with pneumonia, which, of course, is a common complication in pulmonary infarction. Pneumonia ensued in two of Meyer's, and in one of Crafoord's cases there was gangrene of the lung. In one of Schumacker's cases the patient died fifty hours after the operation with empyema of the right pleural cavity from a metastatic bronchopneumonia. In order to exclude as far as possible exogenous infection of the infarcted and infected lung, I had my latest surviving patient placed in a separate room, where nobody except the staff—and they wore masks over their mouths—was allowed to enter. In both my successful cases new threatening thromboses occurred, as also in one of Meyer's cases. In one of my cases the condition of the patient was severely affected by a hemothorax, and was only improved in a definite way when a week after the operation venesection had been performed.

Infection of the wound naturally may occur easily, on account of the lack of time to make the preparations for the operation, and in several of the surviving cases it has endangered the result of the operation. The risk of pleural infection in connection with the opening of the pleura has already been pointed out.

Finally, new pulmonary emboli may threaten the convalescence even when rescued out of the grasp of death.

However encouraging the results may have been during the last few years with Trendelenburg's operation, it seems that only in rare cases will it be possible to save a patient otherwise condemned because of pulmonary embolism. It is upon the prevention of pulmonary thrombosis that we have to place our hopes of being able to defeat at some future time one of the most distressing complications with which, after the victories won by the introduction of antiseptics, surgery has still to wrestle.

It is of interest that the patient who has recovered from an operation for pulmonary embolism may not suffer any lasting inconvenience from the operation. Both of my patients who were cured have recently been examined

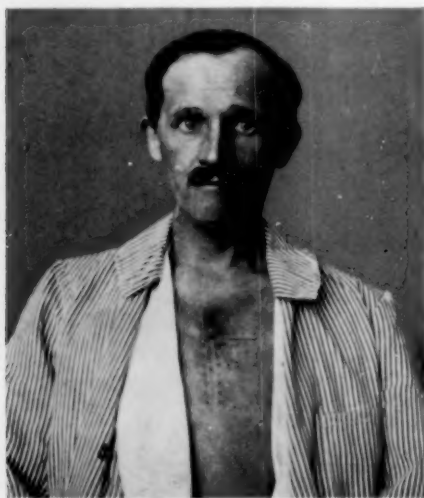


FIG. 24.—The first patient who was cured. (Case IV.) Note the Trendelenburg incision.



FIG. 25.—The second patient who was cured (Case VII). Note single longitudinal incision.

and one of them, the man (Fig. 24) at the end of two years, and the other, the woman (Fig. 25) after a lapse of one year after the operation. Both are in good health. The man works as a farmer and he says he is not as persevering as before his illness and with hard work he feels palpitation of the heart, but he has no shortness of breath from climbing hills and stairways, and he works the whole day. As a result of his thrombosis the legs are swollen in the evenings, but at the time of examination there was no œdema. Beneath the weak part of the chest wall along the sternum there is a sharp systolic murmur, but nowhere else. Pulse 60, blood-pressure 160 systolic. The woman says she is as persevering as before and never is conscious of her heart. The legs are a little swollen at times as a result of the thrombosis, but at the time of examination there was no œdema. As in the former case, a sharp systolic murmur was heard under the weak part of the chest wall, but nowhere else. Pulse 74, systolic blood-pressure 140. In

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both cases, X-ray examinations show no changes which can be ascribed to the embolism.

RECORD OF OPERATED CASES

CASE I.—L. S., female, married, aged sixty-seven years. (Surgical Clinic Uppsala, 1924, A923.) Radical operation for reducible femoral hernia, November 19, 1924. November 27 there was a sudden attack of pulmonary embolism. Within a few minutes there were no signs of life. Operation was performed by Doctor Richter. At first the aorta was opened by mistake and then immediately sutured. From the pulmonary artery there was extracted a great thrombus, which filled both branches of the artery. The patient showed no signs of life during the operation and remained dead.

CASE II.—E. L. S., female, married, aged forty-eight years. (Surgical Clinic, Uppsala, 1927, No. 2263.) Rheumatoid arthritis for two months, ten or eleven years ago. Two years ago there was an operation for umbilical hernia. Eight weeks ago the patient began to complain of shortness of breath and inability to walk any distance. Slight palpitation, no swelling or oedema of the legs. The diagnosis was fatty degeneration of the heart; a reducing régime was recommended. She had hæmorrhoids for more than ten years and came to the clinic for this disability September 7, 1927.

Her general condition was not affected by the local one. The nutrition seemed to be good, the heart sounds were clear, except at the apex, where the first sounds were not quite pure, while the sounds over the rest of the precordium were dull. No arrhythmia, pulse 72. Operation for hæmorrhoids September 9, 1927. The hæmorrhoidal area was excised after the method of Whitehead. There was a normal convalescence except for a complaint of a stitch in the chest on September 14. On September 22 she complained of a sudden stitch below the shoulder blade which developed during the night. There was tenderness and sharp pain upon movement of the left wrist, both shoulder-joints, the ankle-joints, and less pain in the knees. There was severe shortness of breath. Objectively the lungs were negative. On September 22 her temperature was 37.2–37.6 cent., pulse 72–76.

September 23—Temperature was 37.5–38 cent., pulse 80–88.

Before this the temperature and pulse had been entirely normal following the operation.

September 25—She complained of pain in left side, no cough. Temperature still subfebrile, subsiding after a few days.

October 1—In the afternoon she developed a sudden attack, which was at first interpreted as cardiac collapse, on account of the rheumatoid arthritis. Difficulty in breathing developed rapidly, and with it a feeling as if a band had been drawn tightly about the chest; there was marked cyanosis and anxiety. Pulse was arrhythmic with long pauses, but it was not rapid. Two cubic centimetres of camphorated oil were injected subcutaneously, and two cubic milligrams of pantapon. After this there was some improvement. The breathing was deeper, pulse better, cyanosis less. After some five minutes violent vomiting set in; there was still severe anguish, and an increasing cyanosis. Pulse was fairly good, of normal frequency, but arrhythmic. Patient was told to breathe even, deep breaths; the vomiting ceased, her color became somewhat better, as did also her breathing. Five minutes later she was again worse. She was brought to the operating room ten minutes after the onset of this last attack.

Here everything had been made ready for embolectomy. One cubic centigram of morphia was given hypodermically. For the next ten minutes her pulse remained unchanged and then became rapid and there was a progressive deterioration, both as regards the volume of the pulse and the breathing and color of the skin. The sensorium became dim, the pulse was no longer perceptible, the face ashen-gray in color, the eyes turning up under the eyelids. There was complete loss of consciousness, and as it was

decided that death was about to take place, an operation was undertaken by Doctor Nystrom.

Under positive oxygen pressure but with no attempt at narcosis, an incision was made along the left edge of the sternum and perpendicularly to this incision an extension was made along the second rib. There was no evidence of pain while this was being done. About ten centimetres of the second rib was resected. Unfortunately, the pleural cavity was immediately opened. There was slight bleeding from the soft parts of the chest wall, but a very definite loss of blood from the internal mammary artery, which was injured, but this was controlled by the application of artery forceps.

On the left side of the pericardium there was a thick layer of fat, but the nervus phrenicus could be clearly seen. An incision of the pericardium was made in front of and parallel to the nervus phrenicus. The edges of the pericardium were seized with long forceps and kept apart. The heart still showed some pulsation. After a finger had been inserted for orientation behind the large vessels, the Trendelenburg probe was passed with ease, its point projecting to the right of the aorta; a rubber tube was then coupled to the end of the probe and drawn around the vessels. The vessels were immediately lifted and thus constricted by the tube. Thanks to a moderate distribution of fat around the big arteries localization and identification of the pulmonary artery was very easy. After the rubber tube had been drawn tight the wall of the artery was found to be collapsed, soft and yielding; this presented some difficulties in the incision of the wall of the vessel, as it did not offer sufficient resistance. An incision one and one-half centimetres long was finally made in the wall of the artery, the opening was stretched wide with the instrument indicated for the purpose, which gave an excellent support in the subsequent manipulation. The extraction forceps were then inserted. A small resistance was felt at once within the vessel and with the first grasp of the forceps an embolic mass, which seemed to have been just proximal to the bifurcation, was removed. The right branch of the artery was then entered, and blood clots totaling the size of one's finger were extracted. From the left branch, a large branched embolus, probably somewhat larger than that extracted from the right branch, was carefully extracted. In our eagerness a mistake was made in too quickly cleaning out the right branch, so that the embolus was torn, and had to be extracted in several pieces. Finally both branches were once again entered rapidly and were found to be empty. The Trendelenburg artery clamp was now applied to the vessel wall in such a way that it grasped only the edges of the incision; the rubber tube was then released, which permitted the reestablishment of the circulation of blood within the artery. From the moment the rubber tube was pulled tight until it was released it was estimated that a period of time of one minute elapsed, and during this time the heart was absolutely still and respiration stopped. When the tube was released, a light push with the little finger was given to the heart, which immediately responded, first with a single contraction which was followed by others, while almost black blood flowed from a small opening in the incision of the artery which had not been completely closed by the clamps. The heart now made further contractions, rather weak and hesitating, but as far as could be seen, regular, and gradually gained in volume. At the same time the patient drew first a deep breath, and then began to breathe regularly, though at first with long pauses between each breath. The completion of the operation from this point was not hurried. The upper end of the internal mammary artery was ligated, in order that all clamps might be removed from the edges of the wound and make easier access for the suture of the pulmonary artery. The lower end of the artery was not found, but it did not bleed. The incision in the pulmonary artery was closed with five interrupted silk sutures. A pair of rat-toothed forceps, which had been used to draw the wall of the vessel forward when the Trendelenburg clamp was applied was then removed, and were very useful in applying the last suture. The pericardium was next sutured, leaving a gap the size of the calibre of a pea, in order to prevent compression of the heart in case some bleeding occurred from the wound in the artery. It is interesting to note

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that although a small fissure remained in this wound in the artery when the clamps had been removed, the blood never spouted, but only welled forth in a steady stream as if from a large vein.

During the whole operation a positive pressure of oxygen with the Hertel apparatus was maintained in order to prevent collapse of the lung. This, however, did not expand the lung so far as to prevent from seeing the posterior surface of the pleural cavity. From the pleural cavity a few blood clots totaling the size of a child's fist were removed; the cavity was dried out with compresses saturated with rivanol solution, 1 to 1000. Finally sutures of the musculature of the chest wall were introduced. Before the last suture was drawn tight, the positive pressure was quickly increased to twenty centimetres of water pressure, which seemed to be necessary for the lung to expand (the lung tissue being rigid on account of infarction). The skin was sutured with silk.

The patient now had excellent color, was breathing regularly and had a fairly good pulse. She opened her eyes on being spoken to, while she was still on the operating table, and after a short while was able to reply to questions lucidly and clearly. She said she felt well and there was no difficulty in breathing.

The operation as a whole took about a half hour.

October 2, 3 A.M.—Since operation there has been steady improvement. Good pulse, good color, no difficulty in breathing, patient says she feels well. No cough. 1 cubic milligram of morphia, 2 cubic centimetres of camphor subcutaneously.

October 2, 10 A.M.—Temperature 40° C. Breathing somewhat more frequent. General condition fairly good.

Right lung normal breath sounds. Left lung: percussion normal anteriorly and laterally. Breath sounds are full, as far as is possible to determine, towards the axillary line, or possibly the scapular line. The breathing is vesicular anteriorly and latterly, but bronchial in character posteriorly. There is no cough.

October 2, 6 P.M.—Temperature 40.9° C. General condition still fairly good, but breathing somewhat more frequently. Slight increase in cyanosis. Morphia, camphor, sponging.

October 3—Died at 1:20 A.M., thirty hours after operation.

Post-mortem.—In the left pleural cavity 400–500 cubic centimetres of a bloody-colored fluid were found with a specific gravity of 1.047 (normal blood specific gravity 1050). There were 2,970,000 red corpuscles per cubic milligram. The polymorphonuclear leucocytes were several times as numerous as in normal blood, and there were very numerous and thick bacilli of the putrefactive type. As part of the fluid probably is exudate, it can be assumed that the patient lost at the most some 400 cubic centimetres of blood, and as the blood lost during the operation can be at the most 200 cubic centimetres, the total loss of blood would seem to have been about 600 cubic centimetres, not enough to cause death by itself, but important as a contributing circumstance. The body was markedly pale. This is evidence that hæmorrhage has to be very carefully checked, so much the more as the pleural cannot be hermetically closed, and the tendency of the lung to collapse must act as a suction pump upon the wound which is hermetically covered by the skin sutures. In this case a more energetic search for the distal stump of the internal mammary artery ought perhaps to have been made by rubbing the tissues with gauze sponge or other means. An old thrombus was found at the line of suture. There were two transverse lines of rupture of the intima of the vessel corresponding to the place where the vessel had been compressed by the rubber tube, and adhering to this line of rupture was a thick, fat thrombus, extending distally, and, as it seemed, projecting into the right main branch of the artery, although it did not completely close it. The cardiac muscle was flaccid. Hyperstasis was found in both lungs dorsally and inferiorly. Microscopical examination showed changes which must be interpreted as signs of incipient pneumonia.

CASE III.—A. S., female, married, aged forty-five years. Surgical Clinic, Uppsala, 1927 (2889). December 2, 1927.—Cholecystectomy for cholelithiasis. A normal post-operative convalescence. Patient was allowed to leave the bed and lie on couch on December 7. The next day she had a stitch in the left side of the chest and was short of breath and had a slight rise of temperature reaching 38.4° C. (day before $38.7-37.8^{\circ}$). She remained in bed this day and during the next few days. During the next few days the temperature gradually fell, reaching $36.8-37.8^{\circ}$ on December 11 and 36.9° on December 12. The pulse had followed the temperature throughout and had not risen above 84 after the onset of the pain. There were no signs of thrombosis in the legs.

December 12, 1927.—In the evening (about 10 P.M.) the patient suddenly had a typical attack of pulmonary embolism, with dyspnoea, irregular and rapid pulse, and great anxiety. The severity of these symptoms, however, did not last very long and the patient recovered to some extent but was not fully conscious. After morphia and stimulation her condition remained on the whole unchanged during the night and the following day. However, a distinct deterioration set in on December 13, at 5 P.M., and in spite of stimulants the condition grew so serious that at 6:45 P.M. it was decided to perform a Trendelenburg embolectomy and we were encouraged in this by the attitude of the patient's relatives, although they had been told of the poor outlook. The temperature had now risen to 40° C., probably on account of the extensive changes in the lungs which must have been affected by the large embolus that had developed the evening before. The pulse was feeble all the afternoon, and just before operation was hardly perceptible. The physical condition was so bad that recovery seemed almost improbable even though the embolic masses could be removed.

Operation.—NYSTROM, December 13, 1927, at 7 P.M. A few drops of ether were given but when it was noticed that the unconsciousness was deep enough for an operation without narcosis this was discontinued and only oxygen was administered for a short period. A typical incision was made over the second costal cartilage and another at right angles to this incision along the left edge of the sternum. It was decided to attempt the operation without opening the pleura as sufficient time seemed to be available. As the second costal cartilage was divided a small hole was made in the pleura through which air was drawn into the pleural cavity. The opening was situated laterally and could easily be kept closed with a wet compress. The pericardium was opened. The heart made only a very few movements. The next stages of the operation followed the classical procedure of Trendelenburg. During some sixty-five seconds the blood-vessels issuing from the heart were kept shut off with the rubber tubing which was easily introduced behind the vessels. Through an incision in the pulmonary artery about two centimetres in length, embolic masses in the shape of amorphous clots were extracted. They were so soft and fragile that there was no resistance to the forceps, which consequently had to be moved at random. Both branches of the artery were cleared out, the right one twice and the left once, and it was not possible to find the way into the latter the second time. When the rubber tube had been drawn tight the heart and also the respiration stopped. When the tube had been released after closing the incision with the Trendelenburg artery clamps an injection of one cubic centimetre of a 1 to 1000 solution of adrenalin had to be given in order to make the heart resume its contractions. As the left ventricle was not visibly accessible, injection was made into the aorta at its root. This resulted in immediate contraction and a strong pulse could be felt in the radial artery. The patient was in a short time breathing deeply and well and the color of the face was improved. It was found that the pulmonary artery could be sutured with ease. About seventy-five cubic centimetres of blood had leaked out before the sutures were tight. The pericardium was completely closed by sutures and then the remaining wound in the chest wall was closed. The patient gradually regained consciousness, was able to talk, drank water eagerly and said she felt well. Four or five hours after the operation the condition on the whole was still satisfactory, but the pulse was much weaker. The temperature, however, rose higher, and at

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1:15 A.M., December 14, the patient died suddenly as if the artery had been blocked by new emboli.

Post-mortem.—Examination showed that a second embolus had occurred, but it could not to a certainty be decided if the old embolism in the left branch had been added to by a secondary thrombus and these masses suddenly had blocked the right branch, or a new thrombotic mass had become loosened from the pelvic region and in the form of a new embolus had accumulated behind the remnant of the earlier one. The suture line on the inside of the pulmonary artery was absolutely even and clean, without traces of thrombosis; the intima was smooth as a mirror right up to the suture line. There were no gross minor changes in the lung, but microscopic examination revealed incipient pneumonia in the lower portion of the left lung.

CASE IV.—E. D. T., male, farmer, aged thirty-five. Surgical Clinic, Uppsala, 1928 (380). This patient had a normal post-operative convalescence following the removal of an acute gangrenous appendix and the closure of the abdominal wound without drainage. There were no subjective symptoms of thrombi in the legs, but his neighboring patient said that during the night before the third and fourth and fifth post-operative days he did have severe pains in one leg. The temperature had been normal on February 3—37.7° C.—February 4, immediately before the development of the embolism.

February 4, 1928, 3:50 P.M.—When the patient was about to leave his bed for the first time he sat up in bed and suddenly became unconscious. There was cyanosis, he was pulseless and his eyes were rolled up under the upper eyelids. With a diagnosis of pulmonary embolism he was immediately taken to the operating room, arriving there within five minutes after the onset of the symptoms. On the way to the operating room he awoke and became semiconscious. He was pale and very weak, but was unable to reply to questions and did not seem to suffer much. He even smiled while speaking. He complained of no pain in his chest and no pronounced difficulty in breathing, but there was some slight irritative cough. This rapid improvement made the diagnosis a little uncertain and the whole picture looked more like that of brain anemia than a typical pulmonary embolism. After another minute or two he again became worse, with mental confusion, increased pallor, dilated pupils, and after this he was removed to the operating table. As all preparations for operation had been made except the disinfection of the hands of the personnel, the operator and assistant had, immediately upon entering the operating room, put on gloves and gown and were ready for immediate action. When the patient had been removed to the table he had again recovered a little, the pulse could be faintly felt, and signs of a reawakening could be noticed. After a minute or two, however, he was once again completely unconscious and pulseless.

Operation.—NYSTROM. There was no narcosis and the patient was apparently insensitive to all pain. With the usual Trendelenburg incision the second costal cartilage and the adjoining rib were removed, which was done without injuring the pleura. When the pleura was pushed aside, however, an opening the size of a pea was made in the pleura, possibly with a retractor, and this hole was closed with a catgut ligature.

Access to the pericardium was hindered by an unusually large thymus, which adhered stubbornly to the pericardium and had to be cut loose with scissors. In order to gain better access the third costal cartilage was also removed; this increase in the size of the wound greatly facilitated the operation in comparison to the previous ones, when only the second rib had been resected. The left side of the pericardium was found to be tightly stretched over the pulmonary artery, and when it was opened a few cubic centimetres of a clear yellow fluid escaped.

With Trendelenburg's instrument a rubber tube was carried around the great vessels through the sinus pericardii. The heart was beating but the contractions were weak and stopped completely when the rubber tube was drawn tight. Breathing also ceased after this procedure. An incision of about 1.5 centimetres was made in the pulmonary artery. The first excursion with the forceps was unsuccessful. The second attempt, in which the forceps were passed a little higher, found a small clot, which con-

firmed the diagnosis. A suction tube of special construction (Nystrom) coupled to a water suction apparatus, was now inserted, and by this means it was possible to pull the main mass of the thrombus halfway through the opening in the artery. The thrombus was so large that it could not be pulled entirely out of the artery with the suction tube, so that its delivery had to be completed with forceps. The forceps were then inserted into both branches of the artery and small portions of a remaining clot were extracted, then the suction tube was inserted further, first into the right, then into the left branch, and both were found to be empty and only blood was obtained. A Trendelenburg clamp was then applied to the edges of the wound in the artery and the rubber tube was removed. The large vessels had been cut off for 104 seconds, but this had allowed sufficient time to thoroughly remove the thrombi and great care had been taken to place the clamps on the wound in the artery in such a way as to facilitate its closure by suture. The heart had remained still throughout this period, but shortly after the rubber tube was released it gave the first sign of contraction. One cubic centimetre of a 1 to 1000 solution of adrenalin was then injected into the aorta at its base and in one-quarter to one-half minute later rhythmical contractions set in, first feeble, but within another quarter of a minute, stronger and more regular, rapidly increasing to almost violent power and amplitude. Breathing soon began again, the normal color of the face returned, and a good pulse could be felt at the radial artery. The wound in the artery was now sutured and the operation was completed with more deliberation. The pericardium was closed completely. The wound in the mediastinum could not be completely obliterated, although the pleura was drawn forward with catgut sutures. Muscles and skin were sutured without drainage. As the patient began to become conscious during the latter part of the operation and made uneasy motions, he was given a few drops of ether. At the end of the operation he was fully awake, was breathing easily, and asked if he could leave the table, obviously quite unconscious of what he had gone through. When he was taken to his bed, he seemed quite unconcerned, said that he had felt pain in one leg the day before, but that he had not mentioned it to the nurse, as he had thought it was unimportant, and wondered how many days more he would have to stay in bed.

During the first days following the operation the patient had a high fever, but was in good general condition. On the fifth to the seventh days there was a moderate quantity of bloody sputum. On February 10 typical pronounced symptoms of a thrombus in the right leg developed (with swelling and oedema) and on February 18 the signs of thrombosis of the left leg developed. He was discharged recovered on March 17, 1928.

CASE V.—K. G. K., male, aged sixty-nine. Surgical Clinic, Uppsala, 1928 (1048). The patient was in good health until four years ago, when he had a cerebral hæmorrhage. At this time he had difficulty in urinating with considerable frequency. During the month preceding admission there had been vomiting. There was no pain, but for at least two months he felt "out of sorts," with no appetite, very thirsty and had been drinking considerable quantities of water. He lost weight during the last six months. During the night before April 1 the patient was unwell, vomited and felt very weak. On the following day he had about ten vomiting attacks associated with diarrhoea. After arrival at the clinic April 11, 2500 cubic centimetres of residual urine was drawn off.

April 12.—Normal temperature, pulse 90, general condition fairly good. Physical examination demonstrated a typical prostatic adenoma.

April 13.—Bilateral vasectomy was performed.

April 18.—The temperature after operation was quite normal (maximum 37.51 the day after operation) but the pulse was rising, and on April 17 it was 108°, but on the morning of April 18 there was a sudden fall to 60°. In the afternoon of this day there was a rise in temperature to 38.2° C. and the patient complained of urethral pain. There were no signs of thrombosis in the legs. At 10 P.M. the patient grew rapidly worse and there was a sudden onset of pain in the chest radiating towards the back,

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associated with dyspnoea and a weak, irregular pulse. Under continued observation during the following hour the pulse grew steadily weaker and the patient was moved to the operating room. A probable diagnosis of pulmonary embolism was made, and as the heart action grew steadily worse, the Trendelenburg operation was begun under local anaesthesia by Doctor Nystrom. Immediately after the start of the operation the pulse grew a little stronger and more regular, due probably to the effect of the adrenalin in the anæsthetic fluid. The operation was carried out along the classical lines, and when incision had been made in the pulmonary artery the forceps were inserted and no clots were found. A suction tube was then introduced, which drew only blood but found no thrombi. The wound in the pulmonary artery was kept open for seventy-five seconds, after which it was closed with silk sutures in the usual way. The heart resumed action almost immediately when the rubber tube around the large vessels was loosened and increased in power following the injection of 1 cubic centimetre of a 1 to 1000 solution of adrenalin into the bulbous arteriosus. The pericardium was closed and then the musculature of the chest wall. During the latter part of the operation the heart action was very weak and irregular, but this subsequently improved to some extent. At the completion of the operation the patient's condition was very serious, respirations were panting, pulse rapid and feeble. He died at 1:40 A.M., more than two hours after the operation upon the pulmonary artery had been finished. *Pathological diagnosis.*—Prostatic adenoma; chronic cystitis; dilatation of the bladder, bilateral hydronephrosis. No pulmonary embolism was found.

CASE VI.—A. C., female, aged fifty-nine. (Surgical Clinic, Uppsala, 1928, No. 1708). June 26, 1928, appendectomy was performed for a suppurative appendicitis and the wound closed without drainage. The temperature remained high during the first days immediately following the operation, averaging about 38.6° C., and then became subfebrile, 38° C., with a rise of 1/10 degree between July 1 and July 2, and to 38.4° on July 3. Because of the high temperature the thrombosis had been suspected for some days, and on July 3 the diagnosis was made of thrombosis of the left leg because of tenderness over the sheath of the vessel and swelling and œdema of the leg. At 8 P.M., when three nurses were lifting the patient, exercising great care with regard to the danger of an embolism, she felt a pain in her chest, accompanied by intense dyspnoea and cyanosis. She was conscious and able to speak. Recognizing the situation, not a moment was lost before she was moved to the operating room and while at first she seemed to improve a little and could breathe easier, immediate preparations were made for the operation. The symptoms were progressive and death seemed imminent, and operation was performed by Doctor Westerbron. When the operation began at 8:27 P.M. the patient replied to questioning, but the pulse was not palpable. The subperiosteal rib resection was done and the pleura was pushed aside without injuring it. The mammary artery was doubly ligated. During these procedures the condition of the patient became rapidly worse and at their completion the patient was pulseless. The pericardium was widely opened; but the pleura was not opened. The heart was found to be beating very slightly. There was some difficulty in applying the rubber tube around the roots of the artery, because the curve of the instrument was too large, and the tube, which had been put on the apparatus by an assistant, came off the apparatus at the first attempt. The incision in the pulmonary artery was about 12 millimetres in length and upon introducing the forceps several clots, some as thick as the little finger, were extracted. Upon introducing the suction tube it was immediately clogged by a clot, so that the suction was impeded and the rubber connecting tube was collapsed by the suction. Immediately after the thrombus had been removed there was fairly fresh bleeding. The opening of the pulmonary artery was closed after it was clamped with a Trendelenburg clamp. The tube was released, but at this time paralysis of the heart rapidly set in, and no contractions were evident. The vessels had been compressed for at least two minutes. Adrenalin in the right ventricle was without effect, as was also heart massage. The heart was limp as a sack, and the musculature

was so degenerated and infiltrated with fat that the external surface seemed to be composed entirely of fat. When the death of the patient was certain, the opening in the pulmonary artery was widened and a careful exploration made of its interior, and no thrombi, or at least very small ones in the minor branches, were found. Post-mortem examination was not allowed.

CASE VII.—H. C. A., female, aged forty-six. (Surg. Clin., Uppsala, 1929, No. 159). Past history was unimportant and there were no symptoms of heart disease. She was operated upon January 1, 1929, for an acute catarrhal appendicitis, and a small necrosis was found in the mucous membrane of this organ. The wound was closed by drainage and healed by first intention. On January 7 when the back support of the patient was raised somewhat, she suddenly developed symptoms of collapse, became grayish-pale in color, pupils dilated, pulse weak and low (50), but there was no cyanosis or dyspnoea. She recovered after a short time after stimulation with caffeine. Slight mental confusion remained, and she had difficulty in speaking, the eyes were staring and there was a slight deviation of the tongue to the right. Reflexes were normal and there was no paralysis of the tongue. Blood pressure was 170/130. Blood urea was 33 milligrams. Upon examination of the heart its outline was difficult of recognition, the sounds were dull, but there were no signs of thrombosis in the legs. The condition was interpreted as due to weakness of the heart, or possibly cerebral embolism (foramen ovale apertum). The temperature had been subfebrile after operation. After a steady improvement with the temperature remaining subfebrile, on January 18 she suddenly complained of a stitch and sharp pain in the right side of the chest. This was accompanied by severe dyspnoea and the appearance of rales and harsh breath sounds. There were chills and bloody, chocolate-colored sputum. This paroxysm gradually wore off, but was followed by another in about twelve hours. This time the patient was pale, had dyspnoea, but the pulse was good and the heart sounds dull with split sounds heard at the base. The lungs contained moist rales in both axillae with occasional crackles, but there was no certainty of dullness. Temperature 38.8°–36.8°. By January 21 the temperature had gradually fallen to 37.8°–38.2°. Sputum was still blood-tinged and the general condition was not entirely satisfactory. The temperature had continued to fall and on January 23 had reached 37.7°–38° C. and this morning 37.4° C. At 9:34 A.M. there was a definite attack of pulmonary embolism. The patient suddenly became pale (no cyanosis), the pulse weak, respirations panting, eyes rolling upward, but there was no loss of consciousness. She was at once taken to the operating room and placed on the operating table within three minutes after the onset of the attack. There was no time for the operator and assistants to prepare the hands, so gloves were worn. The operative field was washed with iodine and, as the patient was still conscious, local infiltration anaesthesia was applied to the skin. At 9:44 A.M. the incision was made along the left side of the sternum and the third and fourth costal cartilages were resected together with the adjacent portions of the ribs, which was done without damage to the pleura. When an attempt was made to brush the pleura aside with the finger, however, there was a fairly wide tear of the pleura, and this was sutured as carefully as possible. Dissection down to the surface of the pericardium was then done through a longitudinal incision along the edge of the sternum, passing through the loose but tough connective tissue medially to the pleura. The pericardium was opened along the sternal edge. In order to gain space the second costal cartilage also was removed, and the wound in the pericardium was enlarged upwards. Excellent access was now obtained. (No transverse incision was made in the chest wall.) The aorta and the pulmonary artery could easily be surveyed and there was no possibility of their being mistaken. The heart still pulsated fairly strongly and in the soft-walled pulmonary artery strong pulsations could also be felt, but no obstruction, so that the diagnosis seemed doubtful. Meanwhile, the peripheral pulse of the patient had become extremely feeble and the patient was deathly pale, but still the pupils were undilated. She was no longer conscious at this stage.

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The rubber tube was placed around the large vessels in the usual way and when all instruments had been carefully put in position, the tube was pulled tight and the pulmonary artery opened at 10:05 A.M. through an incision about $1\frac{1}{2}$ centimetres in length. A stream of blood welled forth and could be stopped only by tightening the tube very firmly. The spreader forceps were inserted and then by means of the extracting forceps a small embolus was immediately removed; a few larger emboli were brought to light in one or two more grasps, and the two largest were of the thickness of one's little finger about six or seven centimetres in length. The emboli were dark red, soft, and evidently fresh emboli. Both branches of the artery were cleaned out. The suction tube was then inserted, which functioned excellently and easily entered first one branch and then the other, but obtained only blood. When the artery had been filled with blood after slightly loosening the rubber tube, the Trendlenburg clamp was applied to the edges of the incision and the rubber band was released. The artery had been constricted for 105 seconds. While the rubber tube had been tightened, the patient had been lying completely collapsed, with widely dilated pupils and without breathing. Almost instantly when the tube had been loosened, the heart, which during the constriction of the vessels had been motionless, began to beat, feeble at first, but it gradually gained strength. After the injection of 1 cubic centimetre of adrenalin in the bulbous arteriosus the contractions grew stronger and soon became almost violent and with fairly normal rhythm. After a few seconds the patient began to breathe and in a short time respirations were even and satisfactory. Soon after the heart beat had been reestablished, the radial pulse could be felt. While she was still on the operating table she was able to reply to questions. The suturing of the pulmonary artery was now performed with ease. The clamp had not been quite accurately placed on the walls of the artery, and a rat-toothed forceps had to be temporarily applied while the clamp was being moved. At last a tight suture line was obtained. The blood remaining in the pericardium was removed with the suction apparatus. The pericardium was sutured, leaving a small opening at the top for the escape of blood. No bleeding had occurred from the internal mammary artery, which was never seen during the operation. The wound in the thoracic wall was closed with continuous silkworm-gut suture. A thin rubber drainage tube was placed through this wound down to the pericardium. An attempt to suck the air from the pleural cavity by means of Potain's aspirator gave no results. After operation the patient was in collapse, with cold nose and legs. She complained of a severe stitch in the left side (pneumo- and hemothorax?). There was dyspnoea, which was considerably relieved by the inhalation of oxygen. Morphia and camphor were given at 2 P.M. Rectal infusion of salt solution with grape-sugar and brandy was administered. Nobody was allowed into the room without their mouths being covered with gauze masks, in order to prevent exogenous infection of the lungs. It was noticed after operation that the right leg was swollen (the right thigh measuring three centimetres and the calf two centimetres more than the left). Before the operation the patient complained of pain in the right leg. During the afternoon considerable improvement in the general condition of the patient occurred. The skin was warm, there was less pain and breathing was more normal, and oxygen was needed only occasionally. Pulse fairly good, about 120, and the temperature was 38.1° C. On January 25 she passed a comparatively quiet night. She asked for oxygen several times and evidently obtained considerable relief. There was rising temperature (38.4° - 38.5°). General condition distinctly better this morning than yesterday. Skin healthier in color, she is able to speak with less effort, or at least under the effect of morphia her breathing is fairly normal, with a rate of about twenty-five per minute. There is no cough and she has been able to eat.

During the next few days the temperature remained high and there was definite dyspnoea, which was credited to a pneumonia. She was given oxygen with some relief. Five days after operation cough was present and accompanied by a red-streaked sputum. On January 31 there were chills, rise in temperature to 39.7° . There were signs of

exudate in both pleura and upon aspiration 250 cubic centimetres of a bloody fluid was obtained from the left pleura, but no bacteria could be found in the smear of it. From the right side only a few cubic centimetres of blood-tinged fluid were obtained. After this aspiration there was considerable relief. The symptoms of thrombosis in the left leg increased and on February 3 a thrombosis of the right leg manifested itself. On February 22 there was a bilateral bronchitis with a temperature of 39.6° . There was a rapid fall of temperature following this, which was the beginning of a rapid recovery. Patient was discharged practically free from fever on March 30, 1929.

CASE VIII.—S. W., female, aged thirty-eight. (Gynec. Clin., Uppsala, 1929, No. 132.) On March 6, 1929, this woman was delivered of a macerated foetus twenty-eight centimetres in length, and apparently an intact placenta came away with the foetus. On March 7 symptoms of thrombosis of the left leg appeared and on March 9 she showed the first signs of pulmonary embolism, i.e., stitch in back, cough, and a prune-juicelike sputum. On March 10 there was a blood clot the size of a pea in the sputum. On March 20 the pain in the back had entirely vanished and her general condition was very satisfactory. The whole left leg was much enlarged. The temperature, which had been subfebrile for the first few days following the abortion, rose with the onset of the stitch in the back and March 9 to 11 there was constant fever, averaging about 39° C., with a maximum of 39.8° C. On March 14 the minimum temperature in the morning was 38.1° C. and on March 19 it was 38.8° to 39.2° C.; on March 20, 38.8° – 38.8° C.; March 21, 38.6° – 38.6° ; and March 22, 37.6° C. On March 22 at 5:35 P.M. the patient suddenly turned pale, broke into a profuse cold sweat and complained of severe pain in the center of the chest. When the physician in charge arrived within two minutes, the patient was lying panting for breath with a weak and irregular pulse. She was fully conscious and complained that she had difficulty in getting air. She was at once brought to the surgical clinic for operation. As it was evident that the attack would lead to death, operation was undertaken immediately after a very short preparation of the hands of the surgeon and assistant. Anaesthesia was unnecessary as the patient was quite unconscious and did not react to pain. An incision was made to the left of and parallel with the sternum and five to six centimetres of the third, fourth and fifth ribs were excised, beginning at the sternum. When the third rib was resected the left pleura was damaged and the hole was at once covered with a compress. Oxygen was administered under positive pressure. Incision was then made through the pericardium. A rubber tube was placed around the roots of the artery and at this time the patient was still breathing. When traction was made upon the rubber tubing and the pulmonary artery constricted the heart action ceased. Incision was made through the wall of the pulmonary artery and the forceps introduced through this wound, and a thrombus the size of a fingertip was extracted from the right branch of the artery, but it was impossible to find the way into the left branch. A suction tube was inserted, but no more clots were found. The hole in the pulmonary artery was closed with the Trendelenburg artery clamp, after which the rubber tubing was released. It had been drawn tight for seventy seconds. There was no heart action at this time. After an injection of a 1 to 1000 solution of adrenalin into the aorta feeble contractions of the heart occurred, chiefly confined to the right ventricle. These increased but did not quite reach normal. Respirations could not be reestablished. Artificial respiration was given without any real result, except for some improvement in the heart action. Another injection of a 1 to 1000 solution of adrenalin was followed by no result. The heart movement decreased and ceased altogether at 6:05 P.M., in spite of heart massage. The patient during this time was pale and limp and the pupils widely dilated.

Post-mortem examination.—Thrombosis of the veins of the left leg and pelvis. Bilateral pulmonary embolism. Infarction and organization in the lower lobe of the right lung.

CASE IX.—E. E., female, aged thirty-eight. (Surg. Clin., Uppsala, 1929, No. 2665.) Patient had been in the medical wards of the surgical clinic since October 22,

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1920, for a bleeding gastric ulcer. Temperature and pulse were slightly heightened during the first week, Max. 37.7° C. and pulse rate 112. There was no sign of thrombosis. For a few days before the embolic attack, incontinence of urine without any apparent cause, but the day before the attack the bladder functioned normally, and the urine was normal in character. On October 21 swelling and œdema appeared in the left leg and following this the temperature remained normal, while there was slight increase in the pulse rate, reaching 100, and the patient had a strong reaction (Ueber Guaiac) to blood in the faeces.

On November 11 at 12:10 the patient called the nurse and complained of severe stitch in the back upon moving the legs. The physician was immediately called and at 12:15 she was pale with rapid pulse, but even and full. She complained of this stitch in back, which, however, improved in a short time. At 12:20 there was another severe attack of pain with rapid and deep breathing, pulse just palpable. This attack lasted for a half minute, after which time she again felt better. There was no irritating cough, but a belching of gas. The pulse soon recovered, but was irregular, every third beat missing. Morphine injection was given and at 12:25 there was another very severe attack, after which she became unconscious and pulseless with stertorous breathing. She was immediately removed to the operating room and upon arrival she was, to all appearances, lifeless, unconscious, deadly pale, with widely dilated pupils, pulseless and with very irregular respirations.

Operation was begun by Doctor Nystrom at 12:30 P.M. The second and third cartilages on the left side were removed. There was no bleeding following this procedure and the rib resection proceeded as at a post-mortem examination. The line of reflection of the pleura below the fourth cartilage was found at once and the pleura was pushed aside with the finger and scissors from the pericardium without damage. The pericardium was opened. The right ventricle was found making a weak limp movement when it was brought into view. The rubber tube was drawn around the aorta at the pulmonary artery at 12:35 P.M., and the pulmonary artery was opened through an incision of about two centimetres in length. With Trendelenburg forceps the right branch could be entered at once and after a few attempts one or two small pieces of a thrombus were extracted. This proved the diagnosis correct. As the forceps could not get hold of any large embolic masses, the suction tube was inserted, and this at once caught hold of the end of an embolus about ten centimetres in length and about the thickness of a little finger. This was extracted in one piece and appeared like a long worm. Renewed suction with another tube obtained blood only, although the tube was inserted far into the right branch. The left branch was never found with the forceps or suction tube. The hole in the artery was temporarily closed to allow the blood to pass through the vessel. On this occasion about seven minutes had passed since the beginning of the operation and the patient had been lying with irregular breathing and was pulseless for that time. One cubic centimetre of a 1 to 1000 solution of adrenalin was then injected into the bulbous arteriosus. At first no effect could be observed, but when the heart had been massaged for a few movements it began to beat and within less than a minute made strong, regular movements. As the clamp was placed on the wound in the artery, artificial breathing was at once started by means of rhythmic compression upon the chest. This was alternated with inhalation of oxygen and the filling of the lungs with carbon dioxide in order to initiate breathing. After a minute or two the patient drew a deep breath, like the terminal breaths in dying patients which are seen for several minutes after respiration has ceased. These breaths recurred about once a minute, giving some hope that the patient might be brought back to life. Meanwhile, however, the heart action gradually failed and another injection of a 1 to 1000 solution of adrenalin was followed by a small transient effect. The last breath occurred at 12:50 P.M., when the heart action definitely ceased. The difficulty of reëstablishing respiration may have been increased by a lesion of the left pleura, caused by a retractor and resulting in pneumothorax. There now being no hope of restoring life, the pulmonary artery was

opened and by inserting the finger into the artery it was found that the entrance to the left branch, which it had not been possible to find, was just to the left of the distal end of the injection, so that the forceps and suction tube upon entering the lumen of the vessel had slipped passed it. In the left branch large embolic masses were found.

CASE X.—A. N., female, widow, aged sixty-nine. (Surg. Clin., Uppsala, 1929, No. 2830.) This patient, an obese woman, was operated upon for umbilical hernia November 13, 1929. Two days after operation there was considerable fall of the blood platelets (299,000 before operation to 234,000) but there were no signs of thrombosis. She was allowed to leave the bed with her wound healed on November 18. During the night before November 20 she developed a stitch in the chest, which was not localized, and was accompanied by difficult breathing. Her face was somewhat flushed, but there was no pronounced cyanosis. No tenderness or swelling of the legs and no abnormal physical signs were found in the lungs. She was ordered to remain in bed. During the next few days the pain vanished and on November 29 the patient felt well and still had no swelling of the legs. On November 30 while still in bed, there was sudden difficulty in breathing associated with cyanosis. The heart action weakened, many beats not reaching the radial pulse. She was at once removed to the operating room where preparations were immediately made for Trendelenburg operation. Meanwhile she grew rapidly worse, lost consciousness and respirations ceased. Operation (Nystrom) was begun immediately, only three minutes elapsing after the beginning of the attack. A longitudinal incision was made along the left edge of the sternum and the second, third, and fourth costal cartilages with their attached ribs were resected. The left pleura escaped damage, but the right pleura, which reached as far as the left edge of the sternum, was injured, as this risk had not been taken into account because of its unusual position. The pleura was very thin, about the thickness of tissue paper. The hole was closed with a hemostat, after which the pericardium was opened. The heart was found to be still, or at most making fibrillary movements. A rubber tube was passed between the roots of the great vessels and within two minutes the main branches of the pulmonary artery were emptied through an incision in the walls of the vessel. Forceps were first used but obtained only small fragments of thrombi. With a suction tube both the right and left branches were very effectively emptied. The left branch was found at once. A Trendelenburg clamp was placed upon the edges of the wound in the artery and then after light cardiac massage and injection of one cubic centimetre of a 1 to 1000 solution of adrenalin, attempts were made to reestablish the heart beat, but in vain. The heart action was never reestablished, nor was respiration. Insufflation of oxygen into the lungs was without effect. As blood collected in the pericardium, it was believed that the artery wound was leaking, and the forceps were removed, after the rubber tube had again been drawn tight. It was found, however, that the blood issued from a rupture in the wall of the right ventricle, which had been caused by a finger during the cardiac massage, and has passed through the wall into the conus arteriosus. This wall was exceedingly friable. Evidently the case was lost. The patient was dead and remained dead. When the hole in the wall of the heart was examined, it was found to consist of a loose, grayish, muscular layer only two millimetres in thickness, and outside of this was fat. The wall could be ruptured by a very slight pressure between two fingers.

Post-mortem examination confirmed the diagnosis of adipositas and grave chronic myocarditis. Besides this a severe arteriosclerosis, benign nephrosclerosis and cholelithiasis. The emptying of the pulmonary artery had been very complete; the right branch was quite empty of emboli, and in the left branch only a small thrombus, and another small thrombus in one of the secondary branches, but the main branch was quite free.

DISCUSSION: DR. RUDOLPH MATAS, of New Orleans, La.: said that this was a propitious moment to acknowledge the indebtedness of the profession to the Scandinavian

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surgeons for their initiative and enterprise in rehabilitating the surgery of embolism and thrombosis and giving it an impetus and an encouragement that seemed scarcely possible until they infused a new life into it by their successful performance in recent years. Their collective experience has taught us the actual value and the possibilities of surgery in saving limbs and lives hopelessly condemned by embolic obstructions in the arterial system. They have set a remarkable example by their success in the heroic operation devised by Trendelenburg in 1810 for the extraction of massive obturating clots in the pulmonary artery. By their persistent and courageous efforts in this direction they have given a new cast to the Trendelenburg operation and lifted it from the plane of theory and experiment to that of actual practice, and helped to establish it as one of the most dramatic triumphs of modern surgery.

But the modern rise and development of the surgery of the thrombo-embolism in Scandinavia is nothing surprising when we consider that next to Virchow, the father of the doctrine of embolism, that it was Panum, the great Danish physiologist and pathologist, who as far back as the fifth decade of the last century enlarged Virchow's concept of thrombosis by his numerous investigations and experiments which remain as true and fundamental now as they were then. While the pathology and mechanism of *intra-vitam* clotting found its early exponents in Denmark, the surgical treatment of this disastrous complication has been especially developed in Sweden where it is cultivated with a frequency, method and faith in its value that is scarcely found elsewhere.

Of the many notable contributions to this special field of vascular surgery that have emanated from the Scandinavian countries should be mentioned the great work of G. Petré, of Lund, who, in 1913, created an epoch in the literature of post-operative pulmonary embolism by his collective statistical research into the incidence of this formidable complication. He was the first, in 1913, to collect, analyze and classify the great mass of surgical statistics not only from the Scandinavian clinics but from all the leading surgical centres of Europe, particularly those of Germany, which had accumulated up to that time; and it was through this collective statistical survey that we have learned that the occurrence of his fatal massive form of pulmonary obstruction is not evenly distributed as a risk common to all operations, but that it is highly differentiated according to the organs or regions involved, according to the age of the patients and the diseases for which the operations are performed. He showed that an index of incidence based on the gross total number of operations was of little value statistically and that the risk of pulmonary embolism could only be evaluated approximately by classifying and comparing the incidence of this complication in the different regions, age, disease or other conditions that predispose to its occurrence. Thus the index of incidence in thyroid operations is extremely low while that for prostatectomies, hystero-myomectomies and gastric carcinoma is relatively very high.

Since 1913 Petré's paper has served as a statistical model for all the great collective studies that have since enriched the literature of the post-operative pulmonary embolism; as, for example, the Swiss statistics of de Quervain, the serial statistics of the Mayo clinic and the great body of statistics that have been furnished by the German clinics of to-day.

But while the life-saving work of the Scandinavian surgeons in dealing with pulmonary embolism is only second to that of Germany, Scandinavian surgery is unique and is second to none in the systematic and consistent resort to embolectomy for the extraction of the embolic clots from the peripheral arteries. They rehabilitated the operation first performed by the Russian surgeon Ssbanejew, in 1895, but which for eleven years was followed, with one exception, by a succession of discouraging failures. In 1911 they took it up and now according to Einar Key's latest statistics (1929) the operation has been performed and recorded in over 216 cases, including all the great surgical arteries, of which 65 to 70 per cent. have been performed by the Scandinavian surgeons. Indeed, when this experience is compared with that of other countries it

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may well be said that the operation of embolectomy has become largely a Scandinavian specialty.

But in Stockholm, Doctor Crafoord, the assistant of Doctor Giertz, in the absence of his chief made our visit particularly instructive by his personal account of the large experience of the Stockholm municipal hospital in dealing with thrombosis and pulmonary embolism as post-operative complications. Doctor Crafoord himself has to his credit two lives saved by the Trendelenburg operation. To those who are not familiar with the recent studies published by Nystrom, Giertz and Crafoord as they have appeared in the *Acta Chirurgica Scandinavica*, the experience and the hopeful attitude of the Swedish surgeons in anticipating and methodically dealing with this great post-operative emergency is nothing short of a revelation.

Prof. Einar Key, at the Maria Hospital, has personally performed seventeen embolectomies on fifteen patients for obstructing emboli in the main surgical arteries, including one embolus in the abdominal aorta at the bifurcation with recovery. Seventeen embolectomies of the abdominal aorta have been recorded in the world literature, most of them in Scandinavia, with two permanent recoveries. But in regard to the other arteries, about 50 per cent. of the patients have recovered with good circulation when the operation was performed within the first ten hours of the embolic occlusion. There are other factors besides the time interval which influence the mortality and the results, but as a whole this is a remarkably good showing for an operation which is usually performed under forbidding circumstances and which up to eighteen years ago could scarcely claim one recovery to its credit.

DOCTOR GIERTZ, of Sweden: emphasized some things that he thought to be very important. In his clinic three cases had been operated upon. In such cases he would emphasize the importance of the after treatment in the hospital. It is not enough that the surgeon himself should know the symptoms and be able to do the operation. He must train all the people who are working in the hospital, not only the young assistants but also the nurses and the student nurses and the servants, because if an accident happens, the person present in the room must know what to do. In his hospital, when an accident happens, the person in the room has to immediately take the person to the operating room and at the same time telephone to the doctor in attendance and to the nurses in the operating room. In the operating room all the things are ready for the operation. Then the doctor who is to do the operation must know all about the operation.

Another thing important to point out now is that it is wise to avoid the bad cases. We have nowadays enough healthy patients upon whom we have operated for appendicitis, hernia or done an hysterectomy and yet have lost because of an embolus. It is wise to save this operation for such patients, and not operate upon all cases with bad hearts and bad kidneys and very rigid chest cases. It is very difficult in these cases to avoid injuring the pleura.

Another thing in the technic: I am not sure it is necessary to pull the rubber tube very tight. You must remember now the aorta is quite empty and in the pulmonary artery you have the stopping blood on the other side from the plug and it doesn't matter if you lost a little blood, but I am quite sure it is dangerous to pull too tight, and it is not necessary.

DR. FREDERICK T. LORD, of Massachusetts: said that in the experience at the Massachusetts General Hospital, fifty-nine patients, later coming to autopsy, have suddenly lost their lives in consequence of embolism of the pulmonary artery, one or both primary branches or their divisions. If the bad risks are eliminated, the proportion of operable cases is considerably reduced. The exclusion of those dying within ten minutes of the onset, those with inoperable malignant disease, sepsis, circulatory failure and other serious complications leaves twenty-one for consideration, and the number of operable cases is still further reduced to eighteen as the diagnosis was impossible in three. Thus only about one-third of our cases of pulmonary embolism seems suitable for possible operative interference.

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Regarding the diagnosis, it is important to remember that the symptom-complex is not distinctive of pulmonary embolism and inevitable errors in diagnosis will in consequence occur. An appropriate symptom-complex, however, occurring after operation or delivery, the presence of thrombo-phlebitis in systemic veins or a history of pulmonary infarction go far toward establishing the nature of the disturbance. Doctor Nyström referred to the possibility of embolism of small branches and it is unfortunate from the point of view of operation that the blocking of many smaller divisions of the pulmonary arteries by numerous small emboli gives rise to a symptom-complex which cannot be differentiated from obstruction of the main stem and its large accessible branches. There are four such cases, one in about fifteen, in this series.

It is unfortunate, too, from the point of view of differential diagnosis, that there is a confusing group of other conditions with a more or less similar clinical picture. Thus, for example, alarming symptoms like those with pulmonary embolism, initiating a rapidly fatal illness, may occur in elderly persons, post-operatively or not, and at autopsy no pulmonary embolism may be found. Three such cases thought to be pulmonary embolism prior to autopsy have incidentally appeared in my review of our experience. How numerous such instances may be is difficult to determine. Sudden cardiac failure must be excluded. Previous cardiac symptoms will usually serve to differentiate this group. Coronary thrombosis may present identical manifestations. Severe and persistent pain is an important distinguishing feature, but this symptom is absent in a small proportion of such cases. Heart-block may likewise be confused with pulmonary embolism, but a slow pulse should serve to prevent mistake. An acute pneumothorax may present special difficulty in differentiation. The pathologic physiology is here much the same as with pulmonary embolism. In a person in previous good health, there may be sudden pain, suffocation and a sense of impending death, first pallor, later cyanosis, cold extremities, rapid labored respiration and poor pulse. Unconsciousness may ensue. There are five such cases in our records. One ended fatally and was thought to be pulmonary embolism until autopsy showed pneumothorax. Physical examination should, of course, readily permit the diagnosis in this group, but owing to the speed with which operation must be performed for pulmonary embolism, it is readily apparent that mistakes in diagnosis may be made.

The outlook with pulmonary embolism affecting the pulmonary artery or one or both main branches must be regarded as almost absolutely bad. Recovery, however, though rare, may follow complete plugging of one primary branch or incomplete occlusion of the main stem, as suggested by the finding at autopsy of organized thrombi in these vessels.

In attempting to formulate the indications for operation, the difficulty of diagnosis must be appreciated. It seems to me that operation should be considered in patients with a typical complex of symptoms only when this occurs after operation or delivery and with certain or probable thrombo-phlebitis of systemic veins or preceding lung infarcts, and not on patients with arteriosclerotic or hypertensive cardiac disease, with congestive failure, sepsis, inoperable malignant disease, very old persons or those with other conditions in themselves serious.

DR. WILLY MEYER, of New York, said that Professor Trendelenburg did this type of important research work in his sixties. When the speaker visited him in 1909, he was shown the calf on which Trendelenburg had done his first successful operation. They had put long narrow strips of lung tissue, removed aseptically from another animal at the slaughter house, into the deep jugular vein. Everything having been prepared for the operation, when the embolism occurred they did the operation and the animal recovered.

Then fifteen long years passed by. Many surgeons tried the operation, but not one patient recovered permanently until, fortunately, Professor Kirschner, of Koenigsberg, Germany, in 1924, had the first successful case of removal of a pulmonary embolus. Trendelenburg presented him with a set of instruments that he had devised for this

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operation. They are now in the hands of the surgical division of the Lenox Hill Hospital of New York City. At that time we tried them on dogs being prepared for differential pressure. Of three dogs, transpleurally operated upon, two recovered and one developed an empyema of which he died on the twelfth day after operation.

The operation is not difficult. One easily finds with the left forefinger, introduced through the transverse sinus of the pericardium from above downward, the opening where Trendelenburg's large sound has to go through and around the pulmonary artery plus ascending aorta, the tip of the sound meeting the tip of the finger. In this way the sound comes around nicely and cannot injure any vital part. If everything develops successfully the surgeon actually recalls the patient from imminent death to life.

He recalled a remark by Doctor Giertz that the doctor who is trained in this work sleeps in the hospital at Stockholm. Our assistants also sleep in the hospital, but they are younger men. For us here it is necessary that the associates, the adjuncts and even the house surgeons be trained in this particular work, with the required instruments always ready for use, so that they can go ahead and do it in an emergency. He had not the slightest doubt that in the very near future we will hear of successful operations done in our country.

DR. HOWARD LILIENTHAL, of New York, remarked that even though in America we do not all have permanent first assistants dwelling in our hospitals, there is no reason why intensive training in this particular operation, as well as in the diagnosis, should not be given to any house surgeon who shows skill in operating. He should then be given authority to act in emergency. The head nurse should also be taught to recognize the symptoms of pulmonary thrombosis so that she can at once give the alarm and have the patient transferred to the operating room. It must be remembered that patients apparently dead have been resuscitated and have fully recovered after the extraction of emboli from the pulmonary artery.

FURTHER EXPERIENCE WITH RESECTION OF THE ANTERIOR HALF OF THE PYLORIC SPHINCTER

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ONE year ago we reported a group of cases, most of which were duodenal ulcers, in which resection of the anterior half of the pyloric sphincter was done. The results justified the continued use of this procedure and the experience of another year has been added. We have extended the indications of the operation to include cases of pyloric dysfunction other than that associated with peptic ulcer. The establishment of a principle in surgery must await time and experience and above all the judgment of the high court of surgical opinion. To record our experience with this operation without taint of selective advocacy and to set down the principles on which it is based, insofar as our present knowledge permits, are the purposes with which this paper is presented.

The function and mechanism of the normal stomach present many unsettled questions; the pathological physiology is virgin territory for the pioneer. The surgery of this organ has been a vast experiment much of which has been highly successful, yet the percentage of failures, the continual controversy with the advocates of medical treatment and in our own specialty the lack of unanimity of opinion regarding operative procedure, are evidence of misunderstanding and deficient fundamental knowledge.

The subject of peptic ulcer cannot be intelligently discussed without proper regard for the normal and abnormal physiology of the stomach. Since Moynihan's classic description of its symptomatology, peptic ulcer is now readily detected. Also, we have come to know that the typical symptoms may be present even in the absence of ulcer owing to the gastric mimicry when the disease is in the appendix or gall-bladder and even in the exploratory absence of abdominal disease. From autopsy reports we know that frequently ulcers have existed without symptoms. Therefore, it seems logical to assume that the ulcer itself is not the cause of the typical symptom-complex but that the latter may occur independently of ulcer and actually expresses a derangement of gastric function and mechanism of which ulcer may be a sequel. The frequency with which ulcer recurs after any type of operation is an indication of a basic disturbance of gastric physiology.

The most essential factor in the causation and chronicity of ulcer is probably acidity. The rôle of infection from foci within and outside the abdomen may have to do with the origin of the initial lesion in the way of preparing the soil for the destructive action of acid. The main stimulus for

the secretion of gastric juice is the presence of food in the stomach. The stimuli which have to do with the appetite and taste reach the stomach by way of the vagus nerves. Section of these nerves within the thorax is followed by a permanent reduction in gastric acidity. Under normal conditions the stomach probably secretes very little acid in excess of digestive requirements. The newly formed acid has a uniform concentration of about 0.5 per cent. In the absence of excessive secretion the ingested food and liquids and the diluents secreted by the stomach act to reduce the concentration of acid to about 0.2 per cent., which is the optimal for digestion. By the time the contents leave the stomach the acidity of the ejected portion is so low that it is not injurious to the duodenum and is promptly neutralized. There are many conditions which cause a temporary over-production of acid in the stomach; common examples are indiscretions of eating and drinking. It is well known that in such instances there is regurgitation into the stomach of duodenal contents composed of duodenal secretion, bile and pancreatic juice which make up a highly alkaline mixture. The purpose of this regurgitation is, in all probability, to control excessive acidity in the stomach. Stimuli resulting in hypersecretion and over-production of acid reaching the stomach by way of the vagus nerves may originate in a disturbance of the higher nerve centers. This is commonly called nervous indigestion and nervous hyperchlorhydria. In such instances there is usually an associated disturbance of the pyloric sphincter—either failure to relax or actual spasm. The symptoms closely simulate ulcer and, indeed, in long-standing cases, ulcer is actually present. It is well known that peptic ulcer occurs most frequently in individuals of a characteristic nervous temperament which is essentially a constitutional type and not an acquired condition as a result of the ulcer. Is it probable that the hyperacidity in cases of peptic ulcer is due to excessive production of acid resulting from exaggeration of the psychic phase of secretion? When this characteristic is in marked evidence there is likely to be a recurrence of ulceration after operation. Given the conditions in which there is long-continued gastric hypersecretion and over-production of acid and an associated disturbance of pyloric function which acts as a hindrance to the safety mechanism of duodenal regurgitation and neutralization, there will ensue a state of chronic hyperchlorhydria with over-active gastric peristalsis to force the pyloric block. The strongly acid gastric contents are ejected through the pylorus under increased pressure and impinge against the duodenal mucous membrane usually at a point which corresponds to the location of 90 per cent. of ulcers.

It has been established by experiment that peritoneal irritation is a cause of spasm of the pylorus and by clinical experience that it is often accompanied by gastric hypersecretion and hyperacidity—conditions which are favorable for the development of peptic ulcer. Herein may lie the explanation of the frequent association of disease of the appendix or gall-bladder and peptic ulcer, also a plausible reason for post-operative recurrence of ulcer when a diseased appendix or gall-bladder has not been removed.

PARTIAL RESECTION OF PYLORIC SPHINCTER

The ideal treatment for peptic ulcer is the removal of the cause which has to do with its chronicity. This we believe to be an over-production of acid combined with failure of the control mechanism by reason of dysfunction of the pyloric sphincter and its interference with regurgitation of alkaline fluid from the duodenum. Removal of the psychic phase of gastric secretion by section of the vagus nerves within the thorax would seem to be an effective method of controlling hyperacidity. But the physiologic consequences of this procedure on the other abdominal viscera might prove to be forbidding contraindications. In the absence of this fundamental disturbance, experimentally produced ulcers promptly heal. Clinical peptic ulcers undergo partial healing during periods of symptomatic remission and again become active when the causative gastric derangement reappears. The basis of all treatment, medical or surgical, is essentially the control of acidity. If this assumption is correct, efficient medical therapy would necessitate a knowledge of the amount of alkali required for the control of acidity and this quantity would probably vary from day to day depending upon fluctuations in the acidity. Furthermore, the treatment would have to be continued not only until the ulcer has healed but until its causative factors have disappeared, and this may be a matter of years. There is reliable clinical evidence that some peptic ulcers heal under medical management and that others heal without any form of treatment. While in a small percentage of cases there has been a permanent cure, the greater number suffer a recurrence when treatment is interrupted. Many surgeons have seen cases of acute perforation occur while under medical treatment. Cases of peptic ulcer with a short history are claimed by internists and many surgeons to be proper subjects for medical treatment. It is probably true that in many of these cases there is a temporary ulcer diathesis which is amenable to medical control and is unlikely to recur. Of this there is no certain knowledge. The hazards of perforation, hæmorrhage and deformity remain. We have seen many cases of acute perforation where the antecedent history of ulcer has been only of a few days' duration or entirely absent.

Operations for peptic ulcer may be grouped into two main divisions: those which are done for more efficient neutralization of acid (of these gastroenterostomy has been the most successful) and those whose purpose is to eliminate, completely or partially, the formation of acid by resection of the stomach. Gastroenterostomy has made its reputation principally in cases where there has been organic obstruction at the pylorus. It has not been so highly successful in cases of early ulcer without pyloric obstruction, and in these instances it is possible that the causative factors of ulcer have undergone spontaneous correction and left the patient with an unnecessary gastroenterostomy which Moynihan states is a reason for failure of the operation. Is this an example of the fact that gastroenterostomy may be a disease? Gastrojejunal ulcer occurs with disturbing frequency. We advance the theory that its cause is essentially that of the original ulcer—uncontrolled acidity. The alkaline current in the proximal segment may

sweep past the anastomotic stoma without entering the stomach. In such an event the hyperacid gastric contents come in contact with the margins of the stoma and with the jejunal mucous membrane and ulcer develops as it did on the original site in the duodenum or the stomach.

Resection of the stomach for peptic ulcer is an heroic attempt to control acidity. It is claimed for this operation that it removes the ulcer-bearing area of the stomach and duodenum, and that it inhibits or abolishes the secretion of acid by excision of the specific acid cells. Sufficient time has elapsed for it to be known that neither one of the former assumptions is correct, because of the frequency of secondary ulceration after this operation which certainly merits serious consideration. Removal of the entire acid-forming portion of the stomach is a difficult and uncertain procedure. In many cases it is probable that sufficient acid-forming mucosa remains to produce a secretion capable of initiating a new ulcer at the stoma or in the jejunum. We have long felt that gastric surgery for benign lesions should strive for the simplicity in procedure and the least distortion of normal anatomical relationships consistent with results which justify the attempt. The theory which ascribes to acid the predominant rôle in the causation and chronicity of peptic ulcer derives its strongest support from clinical experience and recent experimental studies. It is a theory upon which surgeons and internists are in fairly general agreement. It is unlikely that the normal behavior of gastric acidity could be a factor for evil in the development of peptic ulcer. There are normal fluctuations in acidity and even temporary excesses for which the mechanism of duodenal regurgitation provides a safety control. Otherwise, acid of injurious concentration would exert its destructive effect by causing ulceration of the mucosa with which it comes in contact. Therefore, the origin of ulcer would seem to be in the combination of the two factors—over-production of acid and failure of the safety control of duodenal regurgitation. The unknown urge which causes an excessive formation of acid may be a fundamental nervous derangement which may also act to hinder duodenal regurgitation by causing dysfunction of the pyloric sphincter. In the absence of any means of direct attack to check the over-production of acid, concerted efforts by medical and surgical methods have been made partially to neutralize the high acidity. It seems logical to assume that restoration of duodenal regurgitation may be a solution of the problem, especially since it has been shown that this phenomenon is absent in clinical cases of peptic ulcer. It is with this purpose in mind that we have carried out excision of the anterior half of the pyloric sphincter and thereby removed the hindrance to duodenal regurgitation.

The technic of the operation is simple, with little chance of serious error. It is undisturbing to anatomic relationships and relatively free from immediate or remote post-operative complications. Essentially it is a subserous removal of the anterior half of the pyloric sphincter without penetration of the submucosa or lumen of the duodenum or the stomach. A continuous suture of the serosa closes the remaining defect.

PARTIAL RESECTION OF PYLORIC SPHINCTER

Contraindications to the operation are inaccessibility of the pylorus and the presence of excessive scar tissue in the region of the sphincter.

The chief danger of the operation is an unrecognized accidental penetration of the duodenum which may result in the formation of a fistula.

X-ray studies, made months after the operation, have shown that the action of the pyloric sphincter has been mostly abolished. In cases where there had been gastric retention with evidence of pylorospasm and hyperperistalsis there were now normal peristalsis, no sign of pylorospasm and the stomach emptied in normal time. The operation did not cause an appreciable narrowing of the pyloro-duodenal canal although in a few instances the X-ray detected a slight deformity in this region.

Our cases are too recent to permit an adjudgment of final results, but in the two years of experience with the operation there has been no occasion to re-operate for persistent symptoms of ulcer, and most of our patients report regularly for examination in the Follow-up Clinic. Should the occasion arise, a gastroenterostomy can readily be done.

We believe that the operation of removal of the anterior half of the pyloric sphincter will be as successful as any procedure now used for peptic ulcer. We expect to have some failures, but in these cases the secondary condition will not be so serious as the complications of gastroenterostomy and resection of the stomach.

In our early experience we limited the operation to cases of peptic ulcer. Later on, we applied it to cases of pylorospasm associated with disease of the appendix or of the gall-bladder or hyperchlorhydria alone, using it as an adjunct to the operation for the primary condition with the hope of eliminating post-operative digestive complaints.

Report on Operations in which the Anterior Half of the Pyloric Sphincter Was Removed

Eighty-one cases have been operated on since October 6, 1927.

Duodenal ulcer.—There were forty-two cases. In a number of these cases to be noted, the ulcer was excised in addition to removing one-half of the sphincter. There were five cases of acute perforation and one of chronic perforation. Appendectomy was done in all cases when the appendix had not been previously removed. The procedures in the 42 cases of ulcer were as follows:

Operation on the sphincter alone	14 cases
Operation on the sphincter and cholecystectomy	11 cases
Operation on the sphincter and excision of the ulcer	9 cases
Operation on the sphincter, excision of the ulcer and cholecystectomy	7 cases
Operation on the sphincter, gastroenterostomy and cholecystectomy	1 case

Gastric ulcer.—There were nine cases of gastric ulcer, one of which was an acute perforation. The procedures were as follows:

DEAVER AND BURDEN

Operation on the sphincter, excision of the ulcer and cholecystectomy	1 case
Operation on the sphincter and excision of the ulcer	4 cases
Operation on the sphincter, sleeve resection of the stomach and cholecystectomy	1 case
Operation on the sphincter and sleeve resection of the stomach....	3 cases

Gall-bladder.—There were twenty-three patients who were operated on for disease of the gall-bladder and biliary tract and in whom, in addition to the indicated operation in this region, the anterior half of the pyloric sphincter was excised because of spasm. In the above group one patient had a stone removed from the common duct; one had drainage of the common duct because of biliary cirrhosis; one, in whom the gall-bladder and the common duct had been drained previously, had a secondary drainage of the duct with a T-tube; one patient had a carcinoma of the pancreas and had a cholecystogastrostomy—this patient died five months later—one patient had a cholecystostomy.

Chronic appendicitis with reflex gastric symptoms.—There were six patients in this group. Appendectomy and removal of an anterior half of the pyloric sphincter was done.

Gastrojejunal ulcer.—One patient was operated on for this condition. Three years previously he had had a duodenal ulcer excised and a gastroenterostomy made. At the second operation, at which time the gastrojejunal ulcer was found, the jejunum and the associated ulcer were resected and the bowel joined by end-to-end anastomosis and the anterior half of the pyloric sphincter removed. Nine months later the patient had recurrence of a duodenal ulcer and was again operated on, at which time a gastroduodenostomy was made. Four months following the last operation he reported that he was completely relieved of his symptoms through dysfunction of the pyloric sphincter.

SUMMARY

A corrective procedure which removes the pyloric interference with duodenal regurgitation has been applied in clinical cases of peptic ulcer, pylorospasm and hyperchlorhydria. In this procedure the anterior half of the pyloric sphincter is removed. In an experience with eighty-one cases over a period of two and one-half years, the results have been at least as satisfactory as from any operation we have used in similar cases insofar as symptomatic relief and post-operative X-ray findings are concerned. We have not yet encountered a recurrence of ulceration and, of course, the development of gastrojejunal ulcer is impossible. The removal of the anterior half of the pyloric sphincter is a much simpler operation than gastroenterostomy or resection of the stomach, yet the results are equally satisfactory and the post-operative complications and late sequelæ are much less hazardous.

CONCLUSIONS

The probable cause of peptic ulcer is uncontrolled hyperacidity which is brought about by excessive secretion of acid (probably by exaggeration of

PARTIAL RESECTION OF PYLORIC SPHINCTER

the psychic secretion) and failure of the control mechanism of duodenal regurgitation.

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CARCINOMA OF STOMACH WITHOUT RECURRENCE TWENTY-FOUR YEARS AFTER OPERATION

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Four years ago, while giving a clinic on Surgery of the Stomach at a meeting of the Minnesota Medical Society,* I could show three healthy and happy old men who had cures lasting more than ten years after resection

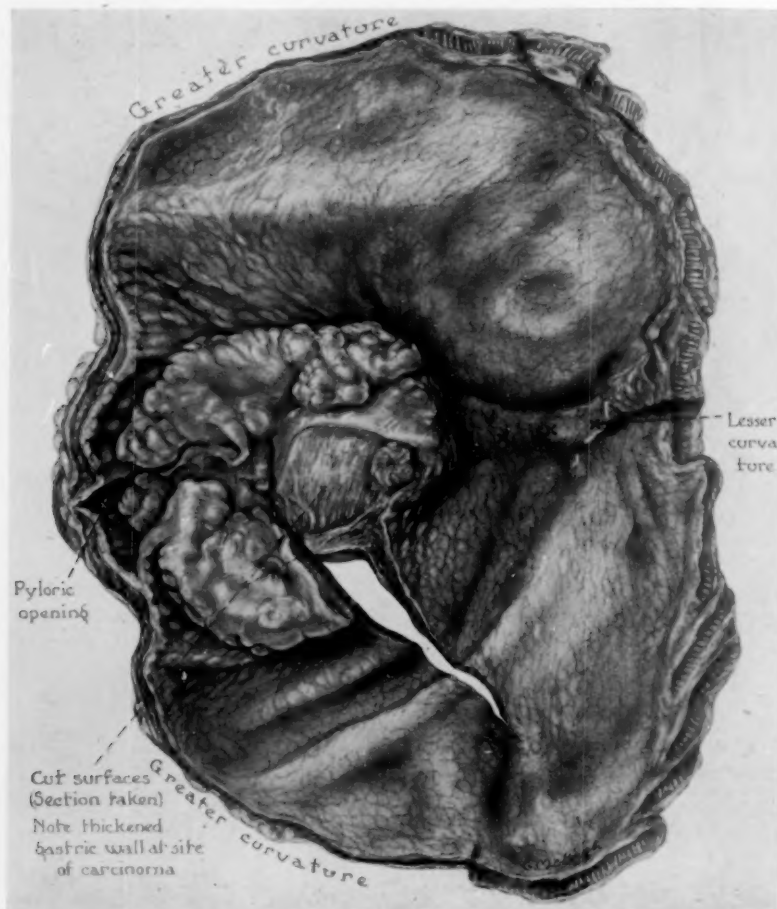


FIG. 1.—Mr. H. Sch. specimen removed at operation, cut open along greater curvature. Drawing.

of the stomach for carcinoma. None of them had been early cases and the resections were extensive. The outstanding feature was the absence of widespread lymphatic involvement. In fact, only the lymph-nodes in direct proximity of the growths were invaded. One of these patients, Mr. F. L. V., sixty years old, was operated upon in September, 1915, at St. Joseph's

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LONG LASTING POST-OPERATIVE BENEFIT STOMACH CANCER

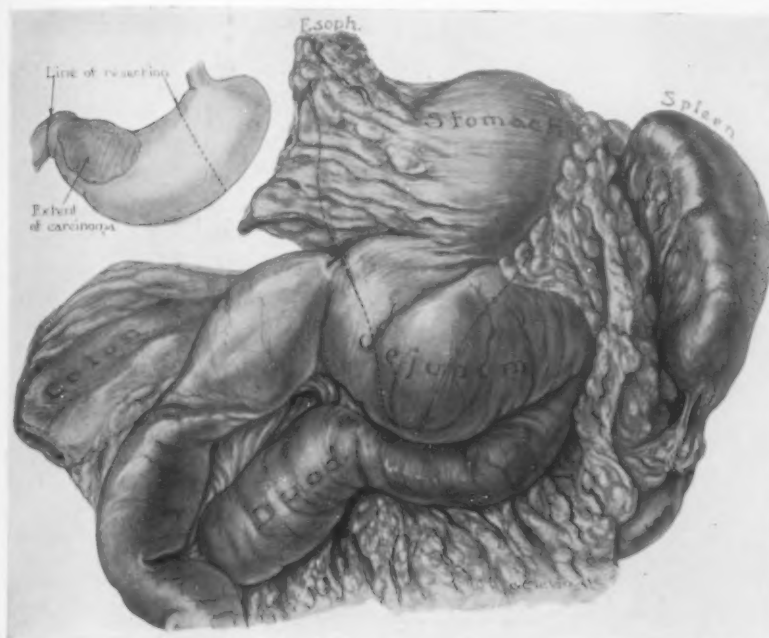


FIG. 2.—Mr. H. Sch. Drawing of autopsy specimen. Stomach is size of fist; afferent and efferent loops of jejunum dilated; ante-colic gastro-jejunostomy.



FIG. 3.—Mr. H. Sch. Posterior view of autopsy specimen.

Hospital. A small piece of liver and some pancreas tissue had to be taken away with the carcinoma of the lesser curvature and posterior wall of the stomach. The tumor was partly adeno-carcinoma, partly carcinoma solidum. This man is well-today, fourteen years and eight months after the operation. The second case, Mr. J. B., was sixty-six years old at the time of his operation, which was in April, 1915. He was reported by his son these very days to feel quite well. It is now fifteen years and one month since the operation. The growth in his case was a carcinoma solidum. The microscopic appearance of the tumor, whether of the glandular or solid type, did not seem to have much bearing on the prognosis. The first-mentioned case was partly a glandular and partly a solid carcinoma; the second a carcinoma simplex, while the third patient, who is the cause of this report, had a carcinoma of the purely glandular type. The microscopic findings were

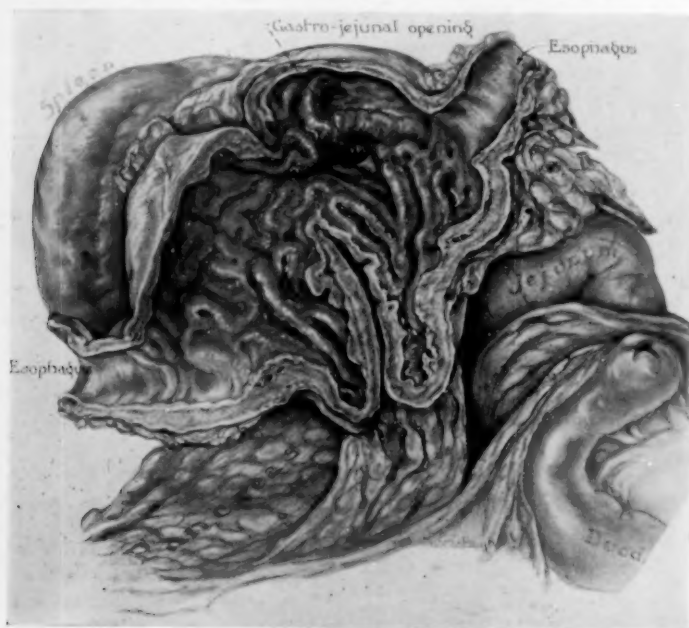


FIG. 4.—Mr. H. Sch. Posterior view. Stomach cut open and divided in half. Posterior half turned down.

verified by Professor Bell, chief of the Pathological Department of the University of Minnesota.

The third case is as follows: Mr. H. Sch. was operated upon in February, 1905, at St. Joseph's Hospital. He was then sixty years old. He died February, 1929, of apoplexy which occurred after the celebration of his eighty-fourth birthday.

Since summer, 1904, he had suffered from pain in his stomach and loss of appetite. His weight had come down from 140 to 109 pounds. The carcinoma involved the lesser curvature near the pyloric area, and was the size of a woman's fist. An extensive resection was done a good distance from the tumor. On the proximal side there were full two inches of apparently normal stomach wall on the removed specimen. This was one of the deciding features for the freedom from recurrence. Examination of the specimen revealed that the tumor mass protruded greatly into the lumen of the stomach and seemed very well outlined. The bordering normal-looking stomach wall showed, however, on its cross-section, some barely

LONG LASTING POST-OPERATIVE BENEFIT STOMACH CANCER

noticeable thickening, which gradually diminished toward the outer regions. Microscopically, it was found, outward from the macroscopic tumor, that the carcinoma extended for two centimetres in the mucosa. The secreting glands were much larger than normal and of irregular shape. There were no metastases in lymph-nodes, beyond invasion by contact in the area of the growth itself. Sections from discrete pyloric and cardiac lymph-nodes as found on the resected specimen showed no metastases, though they were somewhat large, probably on account of a partial ulceration of the tumor. This patient, who left the hospital after twelve days, rapidly gained from 109 pounds, in four months, to 133 pounds, and even reached the weight of 147 pounds, in 1909, four years after the operation. Later, the weight gradually came down again and since the old gentleman approached fourscore, the weight, gradually and perhaps fortunately, ranged in the neighborhood of 110 pounds. In the summer of 1927 he had some diarrhoea and loss of appetite, but this blew over quickly. There was no food distress. He

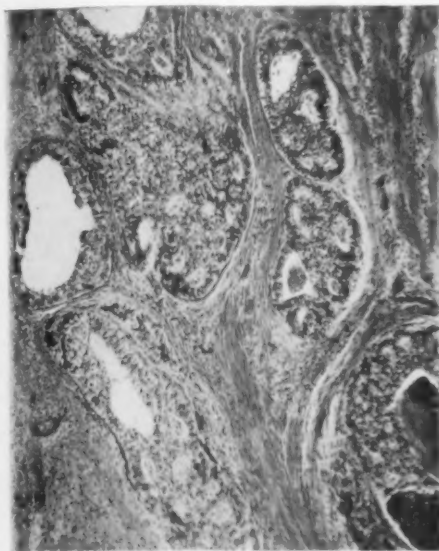


FIG. 5.—Mr. H. Sch. Photomicrogram of tumor.



FIG. 6.—Mr. F. L. V. Partly glandular and partly solid carcinoma; shown for comparison. Cure lasting fourteen years and ten months.

ate of everything that came on the family table, but, since the operation, had to eat slowly. The apoplexy which caused his death was evidently due to the excitement of the birthday party.

The autopsy had to be limited to the abdomen. There was no trace of any recurrence anywhere—no glandular thickening. The lowest portion of the œsophagus was dissected out and was removed in one piece with the remnant of the stomach, the spleen, the pancreas and adjoining small and large gut. The artist of the Department of Pathology of the University of Minnesota then made drawings from front and from the posterior side. The inset gives as near as one could measure the proportions of the resection. After tying off the jejunum the specimen was filled with formalin through a tube tied into the œsophagus. This allowed it to harden in more natural relations. Later the stomach was cut open from the œsophagus down along the greater and lesser curvatures leaving uncut only a small area at the greater curvature. There were no disturbing adhesions either in front

or behind where the lesser peritoneal cavity was entirely free. The only variation of the drawing from the specimen was the upper end of the duodenum, which had been cut in removing the organs.

At the time of the operation we had judged to have removed about two-thirds of the stomach. If this was correct the remainder must have shrunk considerably, even if one allows freely for the infolding suture. The stomach wound had been closed and an anterior gastroenterostomy with an entero-anastomosis between the two limbs of the jejunal loop had been done.

The remnant of the stomach was about the size of a goose egg. The gastroenterostomy opening was just large enough to allow entering of the index finger. It was clean-cut, patent and round though at the operation it had been a two-inch slit. No trace of suture material was found though fine silk had been used throughout. The two loops of jejunum nearest the

stoma were distinctly widened and must have acted as receptacles at the time of eating by filling immediately. No glands or thickenings were anywhere. The patient had been somewhat anæmic as long as we knew him, but the general appearance had remained much the same through all the years.

Pathologists a number of years ago began to feel quite doubtful as to the justification of calling a five-year cure with sufficient assurance a permanent one and asked for eight years of freedom from recurrence. This does not mean more than that at such a late date recurrences would be of rather insignificantly small percentage. There is no definite limit of time to exclude the possibility of recurrence. Very recently we saw a beginning recurrence one month less than ten years after an operation for

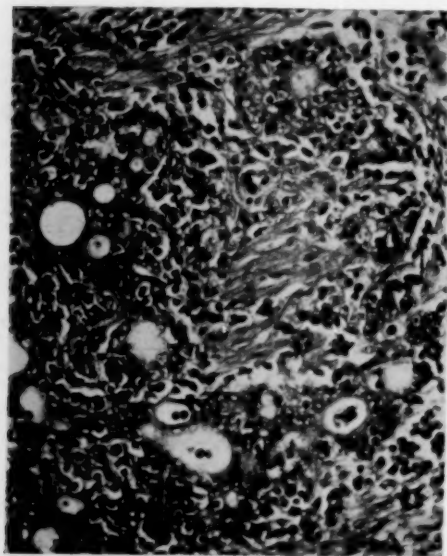


FIG. 7.—Mr. J. B. Carcinoma solidum. High power. Shown for comparison. Cure lasting fifteen years and one month.

carcinoma of the base of the tongue with metastasis in a submaxillary lymph-node. The case had been watched at intervals and was quite well up to the time mentioned. Another case had the first signs of recurrence twenty-two years after operation for carcinoma of the breast. The carcinoma had been rather advanced. A small, hard, whitish lymph-node in the costoclavicular angle had proven carcinomatous. For this reason following the operation the patient received X-ray treatments during six years, the intervals between treatments gradually becoming wider. For twenty-two years she had no trace of recurrence. Then a crop of numerous small nodules appeared on the chest over the area of the operation and one year later she died of widely disseminated carcinoma. On account of the great number of centres of growth in and near the skin flaps of the previous operation this was definitely a recurrence and not a new malignant formation.

THE IMMEDIATE MORTALITY AND LATE RESULTS OF OPERATIONS FOR GASTRIC AND DUODENAL ULCERS

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THIS paper is a report of the results of the operations I have done for peptic ulcer of the stomach or duodenum over a period of ten years, from July 1, 1919, to July 1, 1929, with the addition of eleven pyloroplasties done before July, 1919. While the latter portion of this period does not comply with the requirement of the symposium to give late results for five years, it affords an opportunity for observation of even the latest cases for at least six or eight months after operation.

No operations done for jejunal ulcer or for malfunctioning of a gastroenterostomy are included because these conditions are a different problem from that of a gastric or duodenal peptic ulcer, and would confuse the main issue. Also no cases of acute perforation of a peptic ulcer operated upon as an emergency are included. This report, then, contains all of the cases of gastric or duodenal peptic ulcer and of cicatricial contraction resulting from peptic ulcer that I have operated upon during the ten-year period mentioned, and, in addition, it also contains the eleven cases of pyloroplasty operated upon before July 1, 1919.

There was one case of a rather rapidly advancing type of phagodenic ulcer that was not included because of the type of ulcer. It involved most of the pyloric end of the stomach and was accompanied by œdema of the stomach and by enlarged lymph nodes along both borders of the stomach. About half of the stomach was removed, but the ulcer rapidly recurred. A gastroenterostomy was done, but without relief. Necropsy showed extensive ulceration of almost all of the stomach and perforations posteriorly and up toward the liver where these organs had blocked the perforations. There was no evidence of malignancy, but a rapid extension of an ulcerated and inflammatory condition of the stomach quite unlike peptic ulcer.

In the letter sent out to trace these cases, the following questions were asked: "(1) Do you have any symptoms of indigestion or stomach trouble now when you follow ordinary diet? (2) If you have symptoms, do they bother you very much and are they as bad as they were before you were operated upon? (3) If you have symptoms, how soon did they begin after you were operated upon, and are they continuous or are there spells during which you are completely relieved? (4) Is there any particular medicine or diet that seems to give you relief?"

The results have been subdivided into cases which are symptom-free, greatly improved, slightly improved, or unimproved. The "symptom-free" class includes those patients who have no stomach symptoms under ordinary

J. SHELTON HORSLEY

diet and living conditions, and have had no symptoms of this kind under similar conditions since a few months after the operation. The "greatly improved" are almost symptom-free but will occasionally have some discomfort or slight pain or gas on an ordinary diet. These symptoms do not interfere with the usual occupation and are not sufficient to require any treatment other than the limitation of diet or possibly a dose or two of soda, and occur very infrequently. These patients consider themselves practically well. These two groups are included under the term of "satisfactory results." The "slightly improved" are those in whom the symptoms are pronounced and, while the condition is better than before operation, the patients suffer markedly at times from gas or discomfort or so-called indigestion. A few cases are on the border-line between the "greatly improved" and the "slightly improved." An effort has been made to divide these evenly between the two classifications. The "unimproved" are those patients who are apparently as bad off as, or worse off than, they were before operation. Included in this last group are all the patients who had a recurrent ulcer, for which an operation may or may not have been subsequently done, or who required long periods of treatment without material relief. When a subsequent operation for the relief of gastric symptoms is done, the patient is considered a new case and is again classified from that standpoint.

Of the twelve patients who died following operations for peptic ulcer, on eleven were necropsies done, either limited to the abdomen or including the abdomen and thorax. In one case, a partial gastrectomy, the patient seemed to die from oedema of the lungs and no necropsy could be obtained; but the symptoms and physical signs indicated that this diagnosis was correct.

In all these operations absorbable sutures, usually tanned catgut, were used. The advantages of catgut sutures over non-absorbable sutures, however, are probably not so great as they are often supposed to be. (Table I.)

TABLE I
*Report of operations for gastric and duodenal ulcers,
July 1, 1919—July 1, 1929*

Operations for duodenal ulcer	124
Operations for gastric ulcer	29
Operations for stenosis	4
Operations for adhesions following pyloroplasty	2
Operations for adhesions following partial gastrectomy	1
Total	160
Symptom-free	72—45%
Greatly improved	22—14%
Slightly improved	18—11%
Unimproved	35—22%
Died (9 necropsies)	10—6%
Not traced	3—2%
Total	160
	546

94, or 59%, with satisfactory results.

OPERATIVE RESULTS GASTRIC—DUODENAL ULCERS

11 physiologic pyloroplasties were done previous to July 1, 1919:

Symptom-free.....	3
Unimproved.....	5
Died (necropsies).....	2
Not traced.....	1
	—
Total.....	11

No peptic ulcer of the duodenum was operated upon until medical treatment had been given a trial of at least a few months, except in a few cases when the ulcer was extensive or the symptoms severe.

Pyloroplasty.—In June, 1919, I read before the Section on Obstetrics, Gynecology and Abdominal Surgery, of the American Medical Association, a paper entitled "A New Operation for Duodenal and Gastric Ulcer," and reported eleven patients on whom a pyloroplasty termed "physiologic" had been done.

While mechanically this pyloroplasty resembles the Heineke-Mickulicz operation, the principle of it is entirely different and it is for that reason that I have endeavored to keep it from being classed as a modification of the Heineke-Mickulicz. The operation is based on dividing the sphincter and the pyloric canal of the stomach and excising any ulcer that might be in the first portion of the duodenum. Its object is to give physiologic rest by dividing the most active motor portion of the pyloric end of the stomach and to excise the ulcer. It is not a plastic operation and is inapplicable in a marked stenosis, which was the original indication for the Heineke-Mickulicz operation. The incision in the stomach is at least twice as long as the incision in the duodenum, and the duodenum should not be incised for more than an inch.

In this paper eleven cases were reported. Two died directly from the operation, due to secondary hæmorrhage, a hæmorrhage from an ulcer of the stomach sutured intra-gastrically, pyloroplasty being done to facilitate emptying of the stomach; and a hæmorrhage following division of a stenosis of the pylorus in which the constriction was also cut posteriorly. The first occurred twenty-one days after the operation, and the other eight days after the operation.

To July 1, 1929, there are eighty-four pyloroplasties with three deaths. The third death was in the twelfth case in which pyloroplasty was done. This death was due to uremia in a patient who had a nephritis that proved to be somewhat more severe than was anticipated. This was before the days of the more careful functional examination of the kidneys, and at present the examination of the kidney function would probably contraindicate the operation. All three of these deaths could doubtless be avoided now. Since this case there have been seventy-two consecutive pyloroplasties without a death.

Of the eighty-four pyloroplasties, six were for either constriction due to congenital bands, congenital stenosis, pylorospasm, jejunal ulcer or acutely

perforated duodenal ulcer, and are not included in the results reported. Seventy-eight pyloroplasties were for peptic ulcer or for cicatricial contraction due to peptic ulcer. Of these, sixty-nine were for duodenal ulcer, five as an adjuvant for an operation on gastric ulcer, and four for stenosis following ulceration. Of the seventy-eight cases, all but three have been traced. These show twenty-six symptom-free, nine greatly improved, nine slightly improved, and twenty-eight unimproved. Three died. Including the first two groups as satisfactory results, there are thirty-five, or 45 per cent., with satisfactory or good results.

Dividing these seventy-eight pyloroplasties for peptic ulcer or cicatricial contraction into periods of five years, during the first period of five years, of fifty-seven cases, which include the original eleven cases, eighteen are symptom-free, eight are greatly improved (twenty-six with results satisfactory), four slightly improved, and twenty-one unimproved; three died and three are not traced. During the second five-year period, of twenty-one cases, there are eight symptom-free, one greatly improved (nine with satisfactory results), five slightly improved, and seven unimproved. (Table II.)

TABLE II
Pyloroplasty

84	Pyloroplasties for duodenal ulcer	69	78 reported.
	Pyloroplasties for cicatricial stenosis	4	
	Pyloroplasties for gastric ulcer	5	
	Pyloroplasties for other causes	6	
	First 5-year Period (Old Technic)	Second 5-year Period (New Technic)	Total
Symptom-free	18—32%	8—38%	26—33%
Greatly improved ..	8—14%	1—5%	9—12%
Slightly improved ..	4—7%	5—24%	9—12%
Unimproved	21—37%	7—33%	28—36%
Died	3—5%	0	3—4%
Not traced	3—5%	0	3—4%
Totals	57	21	78

One Finney pyloroplasty was done, for marked stenosis, and is slightly improved.

Two patients have died from diseases not connected with peptic ulcer, and when heard from shortly before death both were symptom-free.

The cause of the unimprovement in many of the pyloroplasties was a recurrent ulcer along the margin of the pyloroplasty incision. In view of the work of Dragstedt and others, who have shown that a peptic ulcer can readily be produced in the pyloric mucosa of a dog by inserting a number of sutures in the mucosa, it was thought that the suturing of the pyloric mucosa as described at first was the cause of these recurrences. Consequently this line of sutures in the pyloric mucosa was abandoned, and after July, 1924 (the beginning of the second five-year period) the operation was done by exclud-

OPERATIVE RESULTS GASTRIC—DUODENAL ULCERS

ing the pyloric submucosa from the sutures and suturing the muscular and peritoneal coats of the stomach to the corresponding tissues on the opposite side in the lower part of the wound, and when the duodenum was reached including in the sutures the whole duodenal wall. Then at the upper angle of the wound again only the muscular and peritoneal coats of the stomach were sutured. Care was taken not to grasp the pyloric mucosa even with tissue forceps. Bleeding points in the submucosa were caught in the sutures.

While this type of pyloroplasty has a field, it is narrow. In my earlier enthusiasm I did the operation on a few cases upon which I would now do something else, possibly a gastroenterostomy or a Finney type of pyloroplasty. When there is much infiltration around the ulcer or when the adhesions are at all marked, especially when they involve tissues other than the gall-bladder, this type of pyloroplasty is not indicated. When, however, there is a single, small, well-defined ulcer in the first part of the duodenum that has not responded to medical treatment, and with no adhesions or with adhesions only to the gall-bladder, and cholecystectomy is done at the same time, or when it is desired to give an easier outlet for the stomach as after excision or cauterization of a gastric ulcer, this pyloroplasty seems indicated.

So far as we could ascertain, the great majority of cases of pyloroplasty that were unimproved or very slightly improved were due to recurrence of the ulcer along the suture line, particularly along the upper or lower border where the knots were tied, or to adhesions. Of the cases with recurrent ulcers, three were operated upon by gastroenterostomy, and of these one is symptom-free, one greatly improved (two with satisfactory results), and one unimproved. Of those in which adhesions of the gall-bladder caused the trouble, two were operated upon for division of adhesions and removal of the gall-bladder, and one of these is greatly improved (satisfactory result) and one unimproved. One case was operated upon for excision of a recurrent ulcer and is greatly improved (satisfactory result). Two gastroenterostomies were done for adhesions, and both patients are symptom-free; one gastroenterostomy was done for recurrent stenosis, and the patient is symptom-free; six partial gastrectomies were done for recurrent ulcer and of these one is symptom-free, three greatly improved (four with satisfactory results), one is unimproved, and one died.

It would seem advisable if pyloroplasty is indicated to do this operation with the chance of curing or greatly improving about 45 per cent. of cases, and of a recurrent ulcer or marked adhesions or stenosis in 36 per cent. The secondary operation would, in these cases, probably be a gastroenterostomy or, in a few cases, a partial gastrectomy. The group that was cured by pyloroplasty seems to be better off than if a gastroenterostomy or a partial gastrectomy had been done as the primary operation, because it is in the type of cases with a wide open pylorus and a small duodenal ulcer that gastroenterostomy is most unsatisfactory. The cases that are apparently cured are well with the physiological functions of the stomach intact; those that

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are unimproved may have to submit to some other type of operation which would be safer and simpler than the operation for jejunal ulcer after gastroenterostomy.

The Finney type of pyloroplasty has been used in only one case. This was done where there was marked stenosis which would be a contraindication for the physiologic pyloroplasty. I have treated the pyloric mucosa in Finney pyloroplasty in a similar way to that mentioned in the last group of pyloroplasties, and though only one Finney pyloroplasty had been done up to July 1, 1929, since that time I have done three.

Gastroenterostomy.—Gastroenterostomy was done in fifty-seven cases. From the first five-year period, containing seventeen cases, ten are symptom-free, three are greatly improved (thirteen with satisfactory results), and three are unimproved. There was one death after operation. From the second five-year period of forty cases, twenty-one are symptom-free, four are greatly improved (twenty-five with satisfactory results), six are slightly improved, three are unimproved, and there were six operative deaths. Necropsies were done after all operative deaths. Gastroenterostomy was done fifty-one times for ulcer of the duodenum, once for recurrent stenosis after pyloroplasty, twice for adhesions after pyloroplasty, twice for recurrent ulcer after pyloroplasty, and once for adhesions after partial gastrectomy. (Table III). During the last five-year period the gastroenterostomy was done without clamps.

TABLE III
Gastroenterostomy

Gastroenterostomies from July 1, 1919, to July 1, 1929.....				57
Duodenal ulcer.....				51
Recurrent ulcer after pyloroplasty.....				2
Stenosis after pyloroplasty.....				1
Adhesions after pyloroplasty.....				2
Adhesions after partial gastrectomy.....				1
	First	Second		
	5-year Period	5-year Period	Total	
Symptom-free.....	10—59%	21—53%	31	} 38, or 67%, results satisfactory.
Greatly improved..	3—18%	4—10%	7	
Slightly improved..	0	6—15%	6—11%	
Unimproved.....	*3—18%	†3—8%	6—11%	
Died.....	1—6%	6—15%	7—12%	
	—	—	—	
Totals.....	17	40	57	

* Two of these patients had jejunal ulcers following gastroenterostomy with clamps for duodenal ulcer.

† One patient had jejunal ulcer following gastroenterostomy without clamps for duodenal ulcer.

Of the seven deaths, two were from cardiac disease. In one of the patients it was known that the heart was in bad condition, but the ulcer was causing such marked symptoms that it was thought best to operate. He died two days after the operation. In another case the patient was seventy-three years old and there was cardiac failure

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after three days. In one case, Mr. O., there was death from leakage in the anterior border of the gastroenterostomy. The symptoms of leakage were not very definite until shortly before death, the patient being rather fat and having some pulmonary congestion. Necropsy showed peritonitis from leakage along the anterior border of the gastroenterostomy and apparently no attempt at healing at any point throughout the whole line of suturing. Although death was on the fifth day, when the stitches were cut the jejunum and the stomach fell apart as though the suturing had just been made. Up to that time (March 11, 1929), I had been placing only two rows of sutures, the inner including all coats and the outer burying the inner row. Since then, however, I have been using three rows of sutures anteriorly.

In another case, Mrs. C., the origin of the jejunum was far to the left of the midline. The patient was rather stout, and the stoma never functioned. There was obstruction in the distal limb of the jejunum due to a kink. A secondary operation was done to straighten this out, but the patient died seven days after the gastroenterostomy. The gastroenterostomy was mechanically faulty.

In another case, Mrs. G., there was an obstruction coming on several days after operation, due to a plastic peritonitis which included the upper loops of the jejunum. This was apparently from a mild infection. It was the type of case that Bevan has included in what he terms "gastroenterostomy disease."

In one patient, Mr. P., there was an extensive infiltration of the duodenum and the gall-bladder was adherent over the duodenum. The gall-bladder was lifted up in order to inspect the duodenum, which seemed firm and brawny. A gastroenterostomy was done and the patient made an immediate satisfactory recovery. On the second day, however, he had pain in the abdomen and shortness of breath, and pain in the chest. As the pain was not very severe, and as some pain following the operation is natural, the diagnosis was not clear. The muscle spasm was not pronounced. He died about twelve hours after the first marked symptoms. Necropsy showed the gastroenterostomy was in good condition but the duodenum had perforated. Evidently there was lymphatic exudate which had bound the gall-bladder over the duodenum and when the protecting gall-bladder was separated the gastric juice digested the fibrinous exudate. There was a small round hole about 1 centimetre in diameter in the duodenum, and the peritoneal cavity was flooded with gastric juice and duodenal contents. The patient died from shock from what was evidently a chemical peritonitis. Since that time I have had several other cases with the same condition, and have not disturbed the gall-bladder but have sutured the tissues around it.

The seventh death was Mr. W., who had a subacute perforation of a duodenal ulcer. It had been partly walled off, and had existed doubtless for several days. After separating the adhesions a small amount of necrotic material was found in the tissues over the ulcer. The perforation was closed by sutures and as this seemed to produce rather marked obstruction, a posterior gastroenterostomy was done. The next day the patient ran a very high temperature and developed pulmonary symptoms, and died six days after operation. Necropsy showed the abdominal condition satisfactory. There was inflammatory infiltration in portions of the lungs; though a complete necropsy on the thorax was not permitted, a small portion of the lung was reached through the diaphragm. Death was apparently due to bronchopneumonia.

Gastroenterostomy has a definite field in the surgical treatment of peptic ulcer, probably the largest field of any operation. It is used when the duodenal ulcer is large, the adhesions are extensive, when there is marked stenosis or inflammation (duodenitis), or when there is a recurrent ulcer after pyloroplasty. If stenosis is not present, the pyloric end of the stomach is ligated with kangaroo tendon, just snugly enough to produce occlusion but not tightly enough to cut off the blood supply. This occlusion lasts several

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weeks, and in some cases several months, but apparently long enough to give the ulcer an opportunity to heal.

Partial Gastrectomy.—The number of partial gastrectomies for peptic ulcer is thirty-two. The gastrectomies on the whole have given satisfactory results, but probably because they were done in most cases for gastric lesions.

In one patient, Mr. McD., a gastrectomy was done because there was a large perforation in the duodenum which had been plugged by the gall-bladder, and it seemed impossible to close the defect without a partial gastrectomy. The patient made an immediate satisfactory recovery, but complained of pain afterwards, which seemed to be due to spasm in the stomach and to the adhesions around the duodenum and the line of union. A posterior gastroenterostomy was done, and afforded him almost complete relief. There was no recurrence of the ulcer.

In twenty-two cases of partial gastrectomy a modification of the Billroth I operation, which I have described elsewhere, was done; in three cases the Finney method; in one case, the Hofmeister; in three cases, the Polya method; in one case, the Billroth I; and in two cases, sleeve resections. (Table IV.)

TABLE IV
Partial Gastrectomy

Partial gastrectomies from July 1, 1919, to July 1, 1929.....							32
	Horsley	Hofmeister	Polya	Finney	Billroth I	Sleeve Resection	Total
Symptom-free.....	11	1	1	2	0	2	23, or 72%
Greatly improved..	4	0	1	1	0	0	results satisfactory.
Slightly improved..	2	0	0	0	0	0	2—7%
Unimproved.....	4	0	0	0	0	0	4—13%
Died (1 necropsy)..	0	0	1	0	1	0	2—6%
Not traced.....	1	0	0	0	0	0	1—3%
Totals.....	22	1	3	3	1	2	32

Twenty-one cases for primary gastric ulcer:

	First 5-year Period	Second 5-year Period	Total
Symptom-free.....	3	11	14
Greatly improved.....	0	4	4
Slightly improved.....	0	1	1
Unimproved.....	0	1	1
Died.....	1	0	1
Totals.....	4	17	21

Four cases for primary duodenal ulcer:

	First 5-year Period	Second 5-year Period	Total
Symptom-free.....	0	2	2
Unimproved.....	0	2	2
Totals.....	0	4	4

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Seven cases for recurrent ulcer after pyloroplasty:

	First 5-year Period	Second 5-year Period	Total
Symptom-free.....	1	0	1
Greatly improved.....	2	0	2
Slightly improved.....	0	1	1
Unimproved.....	0	1	1
Died.....	1	0	1
Not traced.....	0	1	1
	—	—	—
Totals.....	4	3	7

There were two deaths, one after a Billroth I operation for gastric ulcer. No necropsy could be obtained, but clinically, the death, the day after operation, seemed to be from pulmonary œdema. The other death followed five days after a Polya operation for recurrent duodenal ulcer after pyloroplasty. There were marked symptoms of pain and muscle spasm. Necropsy showed death due to perforations of an apparently acute ulcer in the posterior wall of the stomach.

Miscellaneous Operations.—This group includes three cases. In two cases the ulcer was excised: one was a gastric ulcer, and the patient is now symptom-free, and the other was a duodenal ulcer and there was recurrence of the ulcer. In one case the Devine operation was done for an old duodenal ulcer with adhesions, with a recurrent ulcer in the stoma and in the stomach after about six months.

CONCLUSIONS

This report must be considered with the fact in mind that almost all of these patients that were operated upon had been treated medically without cure or marked relief. It seems probable that the vast majority of cases of peptic ulcer can be cured either by medical treatment consisting largely of regulation of diet, or by operation. After any stomach operation medical treatment, particularly regulation of the diet, should be carried out for at least several months. This is just as essential in a stomach that has been temporarily crippled by the operation, until it can recover its tone and function, as it is to use splints after an accurately set fracture until the bone itself has become strong.

The kind of operation done should be suited to the type of lesion present. In a few patients, however, there seems to be an inherent tendency toward recurrence of a peptic ulcer even after multiple operations and careful medical treatment. Fortunately, they constitute a very small percentage of the total number of patients with peptic ulcer. This group can usually be effectively managed along lines of rest for the stomach, such as feeding by jejunostomy for months or even permanently, as recommended by Balfour.

THE IMMEDIATE MORTALITY AND LATE RESULTS OF OPERATIONS FOR PEPTIC ULCER

PERFORMED IN THE PRESBYTERIAN HOSPITAL OF CHICAGO BETWEEN
1915 AND 1930

BY DOCTOR GATEWOOD
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EVER since Rydygier performed his first pyloroeectomy,¹ in 1881, and then made the first gastroenterostomy for benign duodenal obstruction,² in 1884, the problem of the proper treatment of peptic ulcer has been one for the careful consideration of medical men. During the period beginning about 1910, and interrupted by the untimely death of Dr. B. W. Sippy (August 15, 1924), this problem was attacked at the Presbyterian Hospital as a joint piece of clinical research by Doctor Sippy and Doctor Bevan with the co-operation of the other members of the staff.

To conform with the purposes of this symposium I have divided this study into: first, the period between 1915 and 1925 (A), and second, the period from 1925 to 1930 (B). The attempt is to make a complete analysis of the results obtained from operations done in the first period (A). During this period there were 2056 patients admitted to the hospital and discharged with the diagnosis of duodenal or gastric ulcer. Of these, only 207, or 10 per cent., came to operation with a total of 218 separate operations. Excluding thirty acute perforations, almost without exception these patients were seen and managed medically before coming to operation. In occasional instances of extreme obstruction, this management was very short, but frequently it lasted for many months. The average duration of symptoms prior to operation was fourteen years in the cases where date of onset was given. Very often the history merely states "many years," and in some cases the time is not stated. It is obvious that we are dealing with a selected group of patients, the majority of whom are usually classed as "medical failures" although not infrequently the ulcer was found healed at the time of operation.

During this period, thirty patients entered the hospital on account of troubles *after surgical therapy*, chiefly gastroenterostomy. As I have reported nineteen of this group in 1925,³ I will add only that recurrent hæmorrhage was the most common symptom bringing the patient to the hospital—that gastrojejunal ulcer after gastroenterostomy could be demonstrated in six, and, after gastric resection, in two; vicious circle in two; probable recurrence of the old ulcer or a new ulcer in six; and an unnecessary operation in one. In the remaining thirteen cases, the symptoms were attributed to extragastric causes, such as colitis and gall-bladder disease without demonstrable peptic lesion.

RESULTS OF OPERATIONS FOR PEPTIC ULCER

CHART I
Operations for Ulcer

Type of Operation	(A) 1915 - 1925			(B) 1925 - 1930			(A) + (B)		
	No.	Hosp. Deaths	%	No.	Hosp. Deaths	%	No.	Hosp. Deaths	%
Gastroenterostomy.....	163*	3	1.8	101*	4	4	264	7	2.7
Gastric resections.....	13	0	0	17	0	0	30	0	0
Pyloroplasty.....	4	0	0	1	0	0	5	0	0
Excisions.....	3	0	0	0	0	0	3	0	0
Vicious circles.....	4	0	0	2	1	50	6	1	17
Explorations, etc.....	10	1†		5	1†				
Perforations.....	30	6	20	18	8	44	48	14	29

* Series (A): 160 Posterior G.E.
3 Anterior G.E.
† Gastrogastrostomy

* Series (B): 100 Posterior G.E.
1 Anterior G.E.
† Taking down old G.E.

Under "explorations, etc.," are included taking down of gastroenterostomies, gastrogastrostomy, and a number of gastric ulcers which were left alone at the instigation of Doctor Sippy.

The first table (Chart I) covers the type of operations done in both periods, A and B; and the total, A + B, gives the hospital mortality for the entire period. Of the seven deaths, two died of pneumonia, or empyema, two of peritonitis, one of intestinal obstruction independent of the stomach operation, one of continued gastric secretion complicated by herniation of the jejunum into the stoma and one of uretero-pyelo-nephritis. It is of interest to note that only two of these patients who died had been on recent ulcer management or had had pre-operative preparation.

While we have attempted to follow every patient operated upon during this period, this report is concerned chiefly with the ultimate results in the gastroenterostomies. This follow-up has been conducted by (1) personal interview; (2) by report from the surgeon who performed a later operation; (3) by report of attending physician; and (4) by questionnaire. We have been able to obtain accurate data upon all but three patients who report any trouble.

Out of 163 gastroenterostomies, there were three hospital deaths, or a mortality rate of 1.8 per cent. Including these, we have the final results in 89.6 per cent. of all cases, or in 87.7 per cent. of the patients who left the hospital. Seventeen have not been found by diligent search, leaving 146 cases as the basis of this report. One hundred, or 67.7 per cent., of these patients report themselves as entirely, of 100 per cent., well. There were twenty, or 13.7 per cent., who are much improved—some saying 90 per cent.—but having occasional abdominal distress, especially after indiscretions in diet. In the majority of these, the present complaint was definitely due to bowel distress, gall-bladder disease or other extragastric cause, and no X-ray evidence of ulcer could be found. Two have had presumptive gastrojejunal ulcer based on recurrent distress, history of hæmorrhage, relief from soda

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and localized tenderness over the stoma. Both are well several years after medical management. Some of these patients doubtless have recurrence of old ulcers and, in some instances, the ulcer may never have healed. There were sixteen who are classed as "No Improvement or Worse." Eight of these are dead of gastric disease (including subsequent operative procedures). In the last two groups, we find nine, or 6 per cent., of proven gastrojejunal

CHART II

Results of Gastroenterostomy Done for Peptic Ulcer
(Jan. 1, 1915—Jan. 1, 1925)

Results	No.	%
Cured.....	100	68
Much improved.....	20	14
Not improved by G.E.....	16	11
Late gastric deaths*	8	5.5
Deaths from other causes†	7	4.8
Hospital deaths‡	3	2

* Late gastric deaths.—Hæmorrhage, five and one-half years; perforations, five years; suicide on account of g. j. ulcer; "stomach trouble," three and seven years; carcinoma of stomach following duodenal ulcer (three cases), two years, three and one-half years, and five and one-half years.

† Deaths from other causes.—Suicide, five years; tuberculosis, five years; heart disease, three years; aortic aneurism, five years; diphtheria, two years; stroke, five years; accidental death, six years.

Five of these patients were reported by doctors or relatives as having had no further stomach trouble. This would increase the percentage of cures to 71 per cent. and the total cures and improved to 85 per cent.

‡ Hospital deaths.—Pneumonia and empyema, twenty days; peritonitis, six days; peritonitis, two days.

ulcers. Four of these were operated upon in other clinics, four at the Presbyterian Hospital and one came to autopsy. Two of these nine are included in the deaths enumerated in Chart II. In addition, there were at least two who might be termed as gastrojejunal ulcer suspects.

A review of the perforations in period (A) shows that nineteen were operated upon within the first twelve hours with only one death, or a mor-

CHART III

Acute Perforations 1915-1925

Operation	Location				Deaths	Known Recurrences
	Gastric	Duodenal	Not Stated	Total		
Closed only.....	7	11	2	20	4	5
Closed plus G.E.....	0	9		9	1	1
Drained.....			1	1	1	
Totals.....	7	20	3	30	6(20%)	6

tality of 5.3 per cent., as compared with 20 per cent. for the series. That there is little basis for the old notion that the closure of a perforation caused healing of the ulcer and a cure of the patient is shown by the fact that six of this series have had subsequent gastric surgery.

There have been thirty gastric resections done for ulcer in the last fifteen years without a death. In this group there are three known gastro-

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jejunal ulcers (10 per cent.). A number of the resections were done in connection with gastrojejunal ulcer following gastroenterostomy. While the tendency is toward more radical surgery in gastric ulcer, it is evident that this operation does not qualify as ideal.

CONCLUSIONS

1. An analysis of 163 patients treated by gastroenterostomy between 1915 and 1925 shows a hospital mortality of 1.8 per cent. with 82 per cent. of the patients well or greatly improved. Of the remaining 16 per cent., 8.5 per cent. died subsequently of some stomach condition and 4.8 per cent. died of other causes. While the majority of this last group were undoubtedly well as far as stomach symptoms were concerned, they have not been included in the known cures. Considering that this report covers a selected group of patients, gastroenterostomy seems to us to be a very satisfactory operation in spite of the failures.

2. Gastroenterostomy for ulcer in the Presbyterian Hospital during the past fifteen years has been followed by a hospital mortality of 2.7 per cent.

3. Acute perforations operated upon within the first twelve hours carried a mortality of 5 per cent. as compared with a total mortality of 20 per cent. Recurrence of symptoms demanding further surgery occurred in nearly all simple closures and the mortality does not seem to be increased by concomitant gastroenterostomy.

4. Gastric resection for gastric ulcer and gastrojejunal ulcer is an operation which has increased in frequency during the past five years. Although the series is small (thirty) there are three known gastrojejunal ulcers (10 per cent.).

5. The pre-operative medical management of all cases for at least a short period before operation seems to be indicated from an analysis of the deaths in this series.

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RESULTS OF GASTROENTEROSTOMY FOR ULCER OF THE DUODENUM AND STOMACH

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THE purpose of any operation for peptic ulcer is fourfold: (1) to relieve symptoms; (2) to protect against complications; (3) to protect against recurrence of ulceration; and (4) to increase life expectancy. All of these purposes should be fulfilled to the maximum, with minimal operative mortality, morbidity, and removal of normal structures.

It is an established fact that the best results of operation for peptic ulcer depend primarily on the selection of cases and the type of operation to be carried out. It should be made clear that in the cases considered here are included only those in which gastroenterostomy alone has been done for duodenal ulcer. It is possible that in some of these cases the results might have been better if some other type of operation had been chosen, such as excision of the lesion with pyloroplasty or excision combined with gastroenterostomy.

Gastroenterostomy for duodenal ulcer.—Five hundred consecutive cases of duodenal ulcer were studied in which gastroenterostomy alone was done, during the years 1918 and 1919. The results are based on reports received after a minimum of five years after operation. In considering recurrence of ulceration, hæmorrhage, and so forth, I have carried out the study through a ten-year period. The operation was performed in most instances in chronic cases, a point of first importance in obtaining good results from an indirect operation. In a few cases, for various reasons, operation was performed in the early stage of the disease, but in such cases good results are not as likely to be permanent as when operation is performed for chronic and long-standing ulceration. In the series were 416 males and eighty-four females, a ratio of five to one.

In 270 of the 500 cases, actual or impending obstruction was noted, although in a considerable number of these it was not manifested clinically and would not ordinarily be classified as obstruction due to ulcer. The rather high proportion of cases in which there was obstruction, however, emphasizes the point that mechanical defects have been one of the chief reasons for advising operation for duodenal ulcer.

In 16.2 per cent. of the cases, a definite history of hæmorrhage had been given by the patient. Pain was a pre-operative symptom in practically all cases; in only 2 per cent. a history of pain was not elicited and in these cases hæmorrhage or obstruction was the indication for operation.

In a most careful survey of the series, from the standpoint of relief of symptoms, it was found that after operation 87 per cent. of the patients

RESULTS OF GASTROENTEROSTOMY FOR ULCER

obtained relief which they had been unable to obtain by any other means. In 69 per cent. the relief had been either so complete that the patient had paid no attention to diet or to habits of living, or dyspepsia was so slight as to be readily controlled by simple measures. The latter point is one which has not been given sufficient attention, for it is most significant that gastroenterostomy, done on definite indications, enables a patient to control symptoms easily, whereas previous to the gastroenterostomy the symptoms had been more or less uncontrollable. In 18 per cent., the results could be classified as fair. Whereas, in this group, the symptoms of ulcer were under better control after operation than before, the majority of the patients found it necessary to make certain adjustments in diet, and some of them, in order to maintain good digestion, depended on the occasional use of alkalis. A few patients, in spite of diets and alkalis, reported rather severe attacks of short duration. One of these patients, at a subsequent operation, showed the gastroenterostomy to be in excellent condition; the duodenal ulcer apparently had healed, but cholecystitis and pancreatitis were present. The diagnosis, in this case, had been gastroduodenal ulcer. This is illustrative of the fact that other diseases may be responsible for the symptoms in a consideration of disappointing results following gastroenterostomy. The causes of dyspepsia are so manifold that it cannot be expected that gastroenterostomy would protect the patient against all such possibilities.

In 13 per cent. of the series of 500 cases, the patients did not obtain permanent relief from operation. The causes of failure are too numerous to be considered at this time, and many of them are not related to the stomach or duodenum. Diseases that have been overlooked, failure to remove the appendix, functional disorders, and marked indiscretions in habits of living (particularly the excessive use of tobacco or alcohol), and unwillingness to carry out a reasonable regimen following operation, are the more common reasons for disappointment. A significant feature in this group of cases with poor results is that the average of thirty-six and fifty-eight hundredths years is almost ten years less than the average age of forty-four and eight-tenths years for patients who obtained excellent results, which bears out the fact that the younger the patient, the less the prospects of cure.

In the series of 500 patients, the deaths within five years from all causes were twenty-one (4.28 per cent.). From the standpoint of life expectancy this number bears out the investigation carried out by the Actuarial Society of America, in which it was found that among 500 persons of similar age and sex of the white population of the registration area for 1910 in the United States, thirty-one deaths occurred within the five-year period. The operative mortality in the series of 500 cases was 1.80 per cent., there being nine deaths.

In no case in the series, nor in any other series studied, did perforation of the duodenal ulcer, either acute or subacute, occur after gastroenterostomy had been done. In other words, satisfactory gastroenterostomy apparently afforded absolute protection against this serious complication. In none of the

cases in this group did obstruction of the pylorus develop following gastroenterostomy, although I have seen obstruction recur in a case in which the gastroenterostomy opening had been made so small that it became occluded. If adequate drainage is maintained, any obstruction at the outlet will be relieved permanently.

It is more difficult to secure permanent protection against hæmorrhage than to secure protection against any other symptom or complication. Forty-five of the 500 patients (9 per cent.) had one or more hæmorrhages after operation, but it is significant that only one of the 500 died from hæmorrhage. The protection against serious hæmorrhage is, therefore, almost complete, a fact which W. J. Mayo has repeatedly emphasized.

The study also confirmed the fact that such hæmorrhages often are directly associated with unusual physical and mental strain, overloading the stomach, excessive use of tobacco and alcohol, and, as Eusterman has pointed out, to gross dietetic indiscretions and severe focal infection. It should be emphasized also that the ulcer was not excised in any case of this series since only cases in which gastroenterostomy alone was done were investigated. Experience has shown that bleeding is more definitely controlled if the ulcer, or ulcers, are excised in addition to gastroenterostomy.

In an investigation of the cause of subsequent deaths in the series, no instance of carcinoma developing subsequent to operation was encountered.

The protection afforded by gastroenterostomy against the formation of a secondary chronic ulcer is approximately 96 per cent. After most careful investigation of the patients operated on again elsewhere, besides those operated on again in the clinic, I have accurate information of twenty cases with recurrent ulceration (4.07 per cent. of 491 cases), and of these gastrojejunal or jejunal ulcer was listed in sixteen cases, a total percentage of 3.26 occurring in a period of ten years or more after operation. This incidence of recurrence is considerably less than the operative mortality rate of more radical primary operations carried out in a similar group of cases by even the most experienced surgeons. In some of these cases disconnection of the gastroenterostomy loop has protected against reactivation of the healed duodenal ulceration, and in other cases excision of the original lesion and pyloroplasty has proved satisfactory. In the intractable cases of recurrence, partial gastrectomy is indicated, but this operation may fail to protect the patient against the most serious of all complications, that is, a recurrent ulcer in a stomach after resection.

Gastroenterostomy for gastric ulcer.—One hundred cases were studied in which gastroenterostomy alone was done for gastric ulcer, since the surgeon considered it unwise to attempt removal of the lesion. It should be said that the surgical staff of the clinic has always subscribed and still subscribes to the belief and practice that removal of the lesion, if it is reasonably possible, should be a part of the surgical procedure.

This being true, I have been surprised to find so many patients with gastric ulcer who have been completely relieved of symptoms by gastroen-

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terostomy alone. I am convinced that gastroenterostomy alone is the operation of choice in those cases in which the size of the lesion, or its situation, or the age or condition of the patient makes the removal of the lesion, by whatever method, a difficult or hazardous procedure. I would emphasize the point, then, that the group of cases studied represents lesions which were relatively irremovable. I have left out of consideration those cases in which the surgeon noted, at the time of operation, the possibility of the lesion being malignant, so that the study comprises 100 cases unqualifiedly classified as gastric ulcer, in which gastroenterostomy alone had been done ten or more years previously. In a few of these, increased experience might justify the removal of the lesion, but I believe that any improvement in results following radical operation would be more than counterbalanced by the risks of gastric resection.

The operative mortality in this series of 100 cases was 3 per cent. Pain had been the predominant symptom in all cases; in 24 per cent. gross hæmorrhage had been reported, and in 63 per cent. obstruction in some degree had been present. The latter point is worthy of note, since in many cases of even marked obstruction neither the lesion nor the induration about it involved the pylorus.

Seventy-nine per cent. of the patients, five years or more after operation, were relieved. In 50 per cent. the relief had been complete; in 29 per cent. slight and easily controlled symptoms occasionally occurred, the patient considering the results of operation as good. In 4 per cent. the result was classified as fair; that is, the patients were better than before operation, but the condition was not sufficiently relieved to be classified as good. In 17 per cent. the result was poor; that is, little, if any, relief was obtained from the operation.

Gastroenterostomy affords almost complete protection against the complications of perforation and obstruction. One patient was operated on elsewhere because of perforation, but I am not sure that the perforation occurred in the original lesion. Two patients were operated on subsequently for obstruction. Nine and twenty-seven hundredths per cent. of the patients were reported to have had hæmorrhage after operation. The possibility of carcinoma developing in the unremoved lesion is most important; in six cases such a sequel was established or suspected. The fact that all of these cases were listed as gastric ulcer at the time of operation should be conclusive evidence that there is a relationship between gastric ulcer and gastric carcinoma. The desirability, therefore, of removing a gastric lesion is clear, but it should not be removed if removal is a greater risk than the liability of the development of subsequent serious complications.

The subsequent deaths from all causes in this group during five years after operation were seventeen. The expected deaths in a similar number of persons of the general population of the same average age in the same period would be slightly more than six. The death rate in the ulcer group, therefore, was two and a half times the normal.

The protection against recurrence or reactivation of ulcer afforded by gastroenterostomy alone for gastric ulcer is approximately 96.90 per cent. It is a significant fact that gastrojejunal ulcer is not a problem in the treatment of gastric ulcer since the complication did not occur in this group. In cases in which the operation of choice, namely, excision and gastroenterostomy, is possible, gastrojejunal ulceration is almost unknown.

The outstanding fact in the study of this series of 100 cases is that an indirect operation alone for gastric ulcer can be depended on to give a high percentage of good results in cases in which the removal of the lesion, by any method, is difficult, and partial gastrectomy is associated with prohibitive operative risk and an unwarranted sacrifice of the stomach.

Comment.—To avoid any misunderstanding as to the purpose of this presentation, it must be said that gastroenterostomy alone for both duodenal and gastric ulcers, particularly the latter, has been used in selected cases; that is, cases in which other types of operation such as excision and reconstructive gastroduodenostomy, partial duodenectomy, or partial gastrectomy, did not appear to meet, as satisfactorily as gastroenterostomy alone, the requirements laid out in the first paragraph of this paper.

THE RESULTS OF OPERATIONS FOR EXCISION OF ULCER OF THE DUODENUM

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THE results of the treatment of ulcers of the duodenum will probably not be greatly improved until we know more about the origin of the ulcer. It is now known which type of ulcer will respond to the benefit of dietary and medical treatment and should have the benefit of such a regimen. Craftsmanship in the surgical treatment of ulcer has probably developed as far as it is possible to carry it on.

The problem of the etiology of duodenal ulcer has been studied from the clinical, experimental, anatomic and pathologic points of view, and each period brings out new factors, yet the real cause remains unknown.

As a result of better Röntgen-ray examinations and of more frequent and complete post-mortem examinations, we are now realizing that duodenal ulcers are very common. Many of the attacks of dyspepsia which were formerly passed off as of no consequence are now known to be caused by duodenal ulcer. If it were not for the fact that in a small proportion of cases the ulcer perforates, and that in another small group severe hæmorrhage may occur, which occasionally proves fatal, duodenal ulcers might be considered very simple lesions. Carcinoma rarely, if ever, originates in the first portion of the duodenum.

The first local operation for ulcer of the duodenum performed in the clinic was in 1896, and the first excision of a duodenal ulcer was done in 1902; from that time on only a few patients were operated on each year. There are two chief reasons why the operation of excision of ulcer of the duodenum has not gained rapidly in popularity: (1) the results of gastroenterostomy when performed for this condition have usually been satisfactory; and (2) unless the first portion of the duodenum is free and mobile, excision of the ulcer may be very difficult. Unless it is possible to excise the ulcer with less risk and better results than attend gastroenterostomy, there is no occasion for this operation. The ideal operation for any condition is the one which removes the lesion causing the trouble, with a minimum of disturbance, and leaves the least possible chance for recurrence.

If it were not for the occurrence of secondary ulcers in the jejunum in certain cases after gastroenterostomy, the results of this operation in cases of duodenal ulcer would be almost perfect. It is impossible at present to estimate how often jejunal ulcer occurs or to specify the type of case in which it is likely to develop. One of the most interesting phases of the problem seems to be that certain individuals are predisposed to the formation of ulcer and that in such persons ulcer will form repeatedly in spite of eradica-

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tion of all foci of infection and notwithstanding the most rigid treatment and precautions with regard to diet, both before and after operation.

In October, 1926, at the Western Surgical Association, one of us (Judd) reported the method in the clinic of excising duodenal ulcer and the results obtained up to that time. The operation which we now use is the same as we were using at that time, except that as our experience increased, we realized that wide removal of the upper part of the duodenum and particularly of the sphincter gave better results than the earlier operation. Our first operations for excision of ulcer of the duodenum consisted in simple excision without disturbing the pyloric sphincter. It is interesting to find that in these cases the symptoms were not always completely relieved in spite of the fact that the ulcer seldom recurred. The operation was then extended by dividing the pyloric sphincter after excising the ulcer. The ultimate results were identical with those in which nothing had been done to the pylorus, but because of the larger opening on the gastric side, the operation was technically easier to perform. Since certain of the symptoms of ulcer are the result of tension and spasm due to the action of the sphincter, it seemed advisable in all operations for ulcer to do something that would permanently eliminate the action of the sphincter. Plastic procedures, such as dividing and suturing in the opposite direction, and, in fact, any type of plastic operation which leaves the sphincter, do not remove the activity of the sphincter. Function of the sphincter may be slight for some time post-operatively, but after complete healing it is usually just as active as before the plastic operation was performed. Alvarez has studied a number of such cases from the physiologic standpoint and from the standpoint of the motility of the stomach both before and after operation, and it is his belief that it is necessary to remove a large part of the sphincter in order to destroy its activity. Removal of all of the muscle necessitates complete pylorotomy. This seems to be a more formidable operation than is warranted in cases of simple duodenal ulcer, and furthermore, it may be followed by scar tissue and contracture which will interfere with the lumen. A much more conservative and simple operation is the excision of the anterior part, with as much of the sphincter as can be removed easily. This usually amounts to two-thirds to three-fourths of the muscle. Even after such extensive removal, Alvarez has noticed that there is still a tendency for the lumen at the pylorus to narrow by contraction during the process of digestion. Such narrowing may result from the contracture of the small remnant of sphincter muscle left after excision, or it may result from the contracture of the musculature at the pyloric end of the stomach. Doing away with this activity of the sphincter in conjunction with excision of the ulcer of the duodenum is the most important step in the operation. The technical steps of the operation are not difficult so long as good exposure is obtained, and closure is readily carried out if the operation is not attempted in cases in which the ulcer is too far distant from the pylorus, or in which the duodenum is too firmly fixed to be readily mobilized.

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Multiple ulcers.—Increasing experience with the local operation on the duodenum impresses us with the fact that in most instances ulcers are multiple. We usually find an ulcer with a definite crater, or a localized area of duodenitis on the anterior surface of the duodenum, about 1.5 centimetres below the pylorus and close to the upper border of the duodenum. When the duodenum is opened this is found to be a separate and distinct lesion, but also, in almost every case, there is a localized area of duodenitis on the posterior wall of the duodenum just below the pyloric sphincter. In a small proportion of cases there is an ulcer with a definite crater at this point. Although ulcers do occur in other parts of the duodenum, they are exceedingly rare as compared with the areas mentioned. The area of duodenitis or ulcer on the posterior wall is much less extensive than the lesion on the anterior wall and might well be classified as a secondary lesion. In many cases, the posterior lesion may be excised without difficulty; in certain cases it seems best to destroy it with the cautery, and in others, it may be necessary to cut out the ulcer and suture over the posterior surface of the duodenum. We have often treated posterior ulcers in this manner with good results, whereas if the posterior lesion is duodenitis, it has been disregarded.

The operation as we now do it, with extensive removal of the muscle of the sphincter, produces about the same physiologic changes as occur in cases in which gastrojejunostomy is performed. The stomach and duodenum are converted into one continuous part of the gastro-intestinal tract, the contents of the stomach passing quickly into the duodenum. Usually the emptying time of the stomach is not as rapid as it is in cases of gastrojejunostomy. The gastric acids are reduced, but they are rarely absent, as they often are in cases in which gastrojejunostomy has been performed. With the absence of activity of the sphincter, there is an opportunity for the duodenal contents to flow into the stomach, so that if there is anything in the neutralizing effect of these fluids, this is accomplished just as well after this operation as it is after gastrojejunostomy.

Indications for excision and partial duodenectomy.—In view of the fact that we have demonstrated that partial duodenectomy can be done with greater safety than gastroenterostomy, and furthermore, that the ultimate results are as good as they are in gastroenterostomy, we believe that it should be carried out in every case of duodenal ulcer in which it is feasible to do so. We believe, also, that when possible gastroenterostomy should be avoided because of the severity of the symptoms that result when a jejunal ulcer forms. We especially prefer excision and partial duodenectomy if the patient is young, because young patients are more prone to secondary ulcer than patients in middle age and past middle age. We believe that this operation offers all that gastrojejunostomy offers, and removes the ulcer as well. The recurrence of ulcer in the duodenum is not as serious as the formation of a jejunal ulcer. It is an interesting observation that in the nine cases in which we operated after excision of the ulcer and the sphincter, in only one case were we able to demonstrate recurring ulcer. In the other cases, the recur-

rence of the symptoms seemed to be due to the fact that the operative field had been surrounded and interfered with by the formation of adhesions. In the 464 cases in which extensive removal of the upper part of the duodenum with the pyloric sphincter was carried out, there has not been any evidence of infection from the soiling which is bound to occur during the procedure. The operation is done without clamps so that a certain amount of gastric and duodenal contents escapes into the field, but general peritonitis has not followed in any case. In one case, local peritonitis developed later into a subphrenic abscess, but this cleared up immediately after drainage was established. The abscess may have resulted from leakage through the suture line. If so, this was the only case in which there was any suggestion of leakage or perforation following the operation. These results would seem to speak well for the healing power of these tissues, since we were not able in all cases to make an accurate approximation. Stenosis following the plastic operation and following the Billroth I type of operation is not an uncommon occurrence. We have found it necessary to reoperate in many of these cases because of stenosis. We believe that this shows the advantage of saving the posterior part of the duodenum and pyloric sphincter, since in one case only, following this operation, did stenosis of any consequence develop from narrowing of the lumen, and in this case practically the entire circumference of the duodenum and all of the sphincter had been removed. In a few cases, following extensive excision, there was temporary retention, which required treatment for a few days only.

Limitations of the operation.—Fixation of the duodenum and deformity due to long-standing trouble necessitate limiting the operation to a certain extent. The good results we have obtained from excision and partial duodenectomy have undoubtedly been due to the fact that the operation has been performed in those cases in which the duodenum was not fixed or extensively deformed. We believe that gastroenterostomy should still be performed if the duodenum is fixed or extensively deformed, and we believe the operation to be uniformly successful in elderly patients with a long-standing history of ulcer, but a local operation should be done on young patients, even if it necessitates mobilizing the duodenum, and a rather extensive operation.

Results of local operations.—A study of the end-results of the local operations for duodenal ulcer shows that the operation can be done with very little risk. The hospital mortality in this group is low and the relief obtained from symptoms is about as complete and as lasting as from gastroenterostomy.

Table I shows a classification of all of the cases in which operation was performed at the clinic. Early in this work, the operation consisted in excising the ulcer or destroying it with the cautery and then closing the opening in the duodenum, often without exploring the duodenum for other ulcers and without making any attempt to change the activity of the sphincter. The results in these cases were not entirely satisfactory, largely because some of the patients had persistent dyspepsia. Secondary operation rarely revealed

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recurrence of the ulcer. Excision of the ulcer and gastroenterostomy was performed in 219 cases. This procedure gave satisfactory ultimate results, but the immediate risk of the operation was increased. Such operation might well be reserved for those cases in which a deep posterior ulcer is discovered after an anterior ulcer has been removed. Moynihan is of the opinion that the ulcer in these cases should be excised or sutured over, always in addition to gastroenterostomy. Excision and gastroduodenostomy or pyloroplasty, which was performed in 1,002 cases (Table I) included all of the different types of pyloroplasty, such as the Heineke-Mikulicz operation, the Finney operation, the Horsley and Mayo operations, and the operation now in use at the clinic. There were two deaths in this group of cases and in neither was death due to the technical failure of the operation. With increasing experience in these cases, we began to feel that it was also necessary to remove the ulcer and to interfere with the sphincter considerably in order to obtain satisfactory results. We soon found that the best way to do this was

TABLE I
*Procedures in Local Operations for Duodenal Ulcer and Duodenitis
(1906 to 1929, Inclusive)*

	Operations	Hospital mortality	
		Cases	Per cent.
Excision alone (knife or cautery)	361	4	1.10
Excision and gastroduodenostomy or pyloroplasty	1002	2	0.19
Totals	1363	6	0.44

actually to remove the greater part of the sphincter. Instead of making the operation more difficult, it simplified the technical steps considerably. With the anterior part of the sphincter removed, together with the cap of the duodenum, suturing of the stomach and duodenum together was simplified. The structures were approximated with less tension and it was easier to maintain a good lumen.

Table II shows the number of cases in which the foregoing procedure has been carried out from 1924 to 1928 inclusive, a total of 464 cases. We have accurate follow-up records in 369 of these cases. Of the 464 cases, 70 per cent. were men and 30 per cent. were women. The average age was forty years. The average duration of symptoms was eight and a half years. Good results may be expected in persons past middle life who have had a prolonged ulcer history when gastroenterostomy is performed. Our records seem to show that the most unsatisfactory group in which gastroenterostomy was done included the younger patients, and for this reason we have attempted to do the local operation in as many of these younger patients as possible. This question of the significance of the type of operation for patients of different ages was not impressed on us until within the last few years, but increasing experience makes us feel that it is an important consideration.

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TABLE II

*Local Operations for Duodenal Ulcer and Duodenitis
(1924 to 1928 Inclusive)*

Operations performed.....	464 cases
Patients traced.....	369 cases
Males.....	70 per cent.
Females.....	30 per cent.
Average age.....	40 years
Oldest (three patients).....	67 years
Youngest (two patients).....	18 years
Average duration of symptoms.....	8.5 years

Table III outlines the site of the lesion in the different cases. As would be expected, in most instances the ulcer was on the anterior wall of the duodenum. In seven cases the ulcer was on the posterior wall only. Often it is necessary to open the duodenum in order to be sure that there is an ulcer on the posterior wall. If it can be determined that an ulcer with a crater is present on the posterior wall, well below the pylorus, then posterior gastroenterostomy is the better operation. Although it is possible satisfactorily to excise ulcers on the posterior wall, sometimes it is very difficult. In fifty-nine of the cases, there was an ulcer on both the anterior and posterior walls. It is probable that this combination occurred more often than we were able to demonstrate. A small ulcer on the posterior wall may be difficult to find. In almost every case of ulcer on the anterior wall, there is inflammation on the posterior wall. In the cases of ulcer on the posterior wall, the ulcers were excised when possible, and we believe that this should be done whenever it is possible. We have cauterized the ulcer in some cases, and in some cases we have removed the anterior ulcer and have not disturbed the inaccessible lesion on the posterior wall. In this group of cases, the results have been fairly satisfactory, but they were not as good as in those cases in which the anterior ulcer was the principal lesion. In twenty-three cases, the only lesion that we could find was hypertrophy of the pyloric sphincter. These patients all had symptoms of ulcer, although in none was there a good clear-cut history. We opened the duodenum and explored for ulcer, but did not find one. We also examined the mucosa of the stomach in the pyloric region and did not find an ulcer. The hypertrophied muscle was removed in each case, in the same manner as it is removed in excising

TABLE III

*Site of Lesion
(1924 to 1928)*

	Cases
Anterior wall of the duodenum.....	373
Posterior wall alone.....	7
Anterior and posterior walls.....	59
Anterior wall of duodenum and also gastric ulcer.....	2
Hypertrophy of pyloric muscle (ulcer not found).....	23
Total.....	464

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duodenal ulcer. About 70 per cent. of these patients were definitely benefited by the procedure, and the others did not obtain relief from symptoms.

Table IV gives a review of the ultimate results as best we could obtain them from our follow-up system. Of the 369 cases traced, in 333, or 90 per cent., the results were classified as satisfactory. If the percentage is calculated from the 464 cases, which would assume that in those that were not traced the results were not satisfactory, then the percentage of good results would be reduced to 70 per cent. The number of patients not benefited was 8.1 per cent. One striking point which came out in the study of the group in which patients were not benefited was that the original history was not definite and clear-cut of periodic ulcer attacks. Certain of the patients had a fairly typical history of ulcer with associate neurasthenia, and some of these reported that they were not benefited by the operation. Others had intercurrent disturbances in addition to the symptoms of ulcer, and frequently these disturbances persisted after the operation for the ulcer. There were two deaths in the group of 464 cases. Six of the patients have died subsequently. Only one of the latter deaths, however, was in any way attributable to duodenal ulcer.

TABLE IV
Ultimate Results
(1924 to 1928)

Cases	
Operations performed	464
Patients traced	369
Results satisfactory	333 (90 per cent. of those traced)
No benefit	30 (8.1 per cent. of those traced)
Hospital mortality	2 (0.43 per cent.)

Subsequent Deaths as Reported

- One year after operation: suicide
- Two years after operation: operation for recurrent duodenal ulcer
- Two years after operation: cerebral hæmorrhage
- One year after operation: drowning
- Two years after operation: cause unknown
- Three years after operation: operation for brain tumor

Table V shows the number of cases in which there was a history of hæmorrhages before the operation as well as those in which there was a history of bleeding since the operation. There was a history of bleeding before the operation in seventy-three cases. There was a history of bleeding after the operation in nine cases. Seven of these patients had one or more hæmorrhages in from four months to two years after the operation. In some cases there was only one hæmorrhage, in others there were several, but in these seven cases the bleeding eventually subsided and no special treatment has been required. It is possible that, in these cases, a recurrent ulcer was the cause of the bleeding. I believe it is more likely that in most of the cases the hæmorrhage came from inflammation in the duodenum. The results in

these cases would seem to indicate that unless the hæmorrhages frequently recur, operation is not required. In the eighth case in this group, bleeding started five months after operation and continued indefinitely. It was discovered that the patient had hæmorrhagic purpura. After his spleen was removed the bleeding ceased. In the ninth case, because of recurring hæmorrhages, the patient was reoperated on and gastroenterostomy was performed. A recurring ulcer could not be demonstrated.

TABLE V
Clinical Manifestations
(1924 to 1928)

	Cases
Typical ulcer history.....	402
Gastric acidity { average combined acids.....	68
{ average free hydrochloric acid.....	51
Hæmorrhage as a symptom	
History of bleeding before operation.....	73 (15.73 per cent. of the 464 cases)
History of bleeding after operation.....	9
(1) Hæmorrhage one year after operation	
(2) One hæmorrhage four years after operation	
(3) One hæmorrhage four months after operation; no recurrence fifteen months later	
(4) One hæmorrhage fifteen months after operation	
(5) One hæmorrhage four months after operation; three years since last hæmorrhage	
(6) One hæmorrhage two years after operation	
(7) One hæmorrhage five months after operation	
(8) Repeated hæmorrhages beginning five months after operation; splenectomy for hæmorrhagic purpura in one and a half years; no bleeding since splenectomy (seven months)	
(9) Operation for recurrent hæmorrhages in three years; first hæmorrhage came one year after original operation which was for bleeding duodenal ulcer; second operation: gastroenterostomy; the mucosa of the stomach was red and congested and showed definite gastroduodenitis	

Table VI gives a review of the post-operative complications. As is to be expected, the most prevalent complication in this group of cases is that of some form of pulmonary infection. It is a striking observation, however, that in this particular group of cases, in which there is a local operation on the pylorus and duodenum, the patients are not as prone to pulmonary complication as in those cases in which gastroenterostomy is performed, or some other operation is carried out on the body of the stomach. Twelve of the patients in this group had pneumonia, five had pleurisy, three had pulmonary infarcts, and thirteen had bronchitis. Pneumonia was fatal in one case. Phlebitis occurred in eight cases. The wound was infected to a sufficient degree to prolong the convalescence in thirteen cases. In a number of others there was serum in the wound. We believe that the abdominal wound in this group healed better than the abdominal wound in most operations on lesions of the stomach, and that the contamination from this part of the stomach and intestine does not result in severe infection as frequently as it does elsewhere. In spite of the fact that extensive resection of the upper part

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of the duodenum was done in many of these cases, in only twelve of them was there gastric retention at any time. In most of these, the gastric retention was temporary and cleared up within a few days, but in three cases it was necessary to reoperate several months later because the stomach did not empty as well as it should.

TABLE VI
Post-operative Complications
(1924 to 1928)

	Cases
Pulmonary.....	33
Pneumonia.....	12
Pleurisy.....	5
Pulmonary infarct.....	3
Bronchitis.....	13
Phlebitis.....	8
Wound infected to a sufficient degree to prolong convalescence.....	13
Gastric retention (temporary).....	12
Hospital deaths.....	2
One died from bilateral bronchopneumonia; and one from carcinoma of pancreas not recognized at operation	

Table VII gives a short résumé of the cases in which a secondary operation was done because of failure to relieve symptoms by excising the duodenal ulcer and removing the pyloric sphincter. In only one of these nine cases were we able to find a secondary ulcer. The failure of the operation in most cases seemed to be due to the fact that the operative field had become sealed to the parietal peritoneum or to the liver by dense adhesions. In each of these cases in which we were able to mobilize the duodenum at the second operation, we were also able to demonstrate that the lumen at the point of the first operation was sufficient.

TABLE VII
Secondary operation on account of recurrent symptoms (1924 to 1928)

Case

- 1 Symptoms recurred in five months. Operation in two and a half years. A recurrent duodenal ulcer was found with chronic perforation and attachment to the gall-bladder. Posterior gastroenterostomy was performed.
- 2 No symptoms for two years, then began having distress with symptoms of retention. Operation in two and a half years. The pyloric end of the stomach was adherent to the round ligament of the liver, suggesting that this caused the obstruction, for when the duodenum was freed the pyloric outlet seemed ample and no ulcer was found. Posterior gastroenterostomy was performed.
- 3 Symptoms recurred in two years. Operation in three years. Thickening found on superior border of duodenum but no ulcer was present. The duodenum was mobile and there was an ample lumen at the pylorus. Posterior gastroenterostomy was performed.
- 4 Symptoms recurred in eight months, retention gradually increasing. Operation in two and a half years. Obstruction at the site of the old operation caused by adhesions between the anterior suture line and the parietal peritoneum. No ulcer found. Separation of adhesions and posterior gastroenterostomy were done.

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- 5 Symptoms of retention while still in the hospital. Operation in six months on account of retention. The duodenum was adherent to the under surface of the liver and was not freed. Posterior gastroenterostomy was performed.
- 6 Operation elsewhere in two years for recurrence of symptoms. Patient died from mesenteric thrombosis.
- 7 Operation at clinic for bleeding duodenal ulcer. Recurrence of the hæmorrhages in one year. Operation in three years. There was ample lumen at the pylorus; small scar from former operation. No ulcer found. Posterior gastroenterostomy done. The mucosa was reddened. Bleeding probably due to gastroduodenitis.
- 8 At the first operation there was an ulcer on the anterior duodenal wall, also a large ulcer on the posterior wall; in addition, cholecystitis with multiple stones and chronic catarrhal appendicitis. Appendectomy and cholecystectomy were performed. The anterior duodenal ulcer was excised with the anterior half of the pyloric sphincter. The posterior ulcer was not disturbed. Ten months later there was recurrence of symptoms and the patient was operated on elsewhere. The report stated that partial gastric resection was performed.
- 9 Symptoms recurred in seven months. Operation in two years. An ulcer was not found in either the stomach or duodenum, and there was very little evidence of the scar of the previous excision. The pylorus was adequate to drain the stomach well. Posterior gastroenterostomy was performed.

SUMMARY

This paper consists of a report of the local operations which have been performed in The Mayo Clinic for duodenal ulcer. The first local operation in the clinic for ulcer of the duodenum was a Heineke-Mikulicz operation in 1896, and the first operation for excision of ulcer of the duodenum was in 1902.

Gastroenterostomy will probably remain the popular operation for duodenal ulcer. It is satisfactory in all cases except in those in which secondary ulcers develop, and in those in which hæmorrhage occurs and in which bleeding may continue.

The operation of excision was developed to be used in those cases in which it was possible to carry it out safely, with the idea of avoiding jejunal ulcer and possibly reducing the number of cases in which bleeding continues after gastroenterostomy for hæmorrhagic ulcer.

For many years, the local operation consisted in excision of the ulcer or destruction of the ulcer by cautery with simple closure of the area in the duodenum. Of late, it has been felt that removal of the anterior part of the pyloric sphincter, in addition to excision of the ulcer, produced more complete relief from symptoms. With this removal of muscle, everything is accomplished that gastroenterostomy can accomplish, and, in addition, the ulcer is removed.

In cases in which multiple ulcers are encountered and in which it is not possible to remove all of them, it is probably best to remove the anterior ulcer, close the opening in the duodenum, and then to complete the operation with gastroenterostomy.

The local operation is limited to those cases in which the duodenum is fairly mobile. As one's experience increases with these cases, however,

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one realizes that it is not difficult to mobilize a duodenum that is fairly well fixed, and this should be done in cases in which excision of the ulcer is definitely indicated.

Gastroenterostomy is particularly satisfactory for older patients, especially if obstructive symptoms have developed. Gastroenterostomy is less satisfactory in young patients.

A study of the immediate results from local operation shows that it can be done with very little risk. This report covers 1,363 cases with a mortality of 0.44 per cent.

The ultimate results in this group of cases are practically the same as the ultimate results obtained by gastroenterostomy; the patients in 90 per cent. of the group in which we have detailed reports have obtained satisfactory results.

The local operation can be performed in about 50 per cent. of the cases of duodenal ulcer, and in these, better immediate and ultimate results will probably follow than from gastroenterostomy.

THE ULTIMATE RESULTS AND THE ACTUAL FUNCTIONAL
RESULTS AFTER THE DIFFERENT TYPES OF OPERATIONS
FOR GASTRIC AND DUODENAL ULCERS, FOR GASTRIC
CANCER AND FOR HOUR-GLASS STOMACH AFTER
AN INTERVAL OF FIVE YEARS OR MORE

By JOSEPH C. BLOODGOOD, M.D.

OF BALTIMORE, MD.

THIS is a brief summary of forty years' study and observation of surgery of the stomach, especially in relation to resection, gastroenterostomy and Finney pyloroplasty.

When I was writing annual reviews of the literature for the December numbers of *Progressive Medicine*, published by Lea and Febiger, of Philadelphia, from 1899 to 1918, I remember distinctly short articles by surgeons of more than twenty years' experience, giving, in an authoritative way, their conclusions after this long period of study. I was impressed that I found more of the fundamentals in contributions of this kind. There was nothing original, but brief statements of things that had been tested and found correct.

I have before me the actual histories of cases of lesions of the stomach personally observed by me, and on which I have operated since 1900. I have a number of examples of cases who have lived for more than twenty years since the operation and who are apparently well today. We know the exact function of the stomach from letters from the patients and their physicians. After every type of gastric operation that I have performed I have a post-operative X-ray picture—one of them more than twenty-six years after operation. (1904 to 1930.)

The ultimate results ascertained from patients and physicians have been brought up to April, 1930, by Mr. George Thompson, a student in the medical department of Johns Hopkins and a special student under the Garvan fund in the surgical pathological laboratory. Today he has finally traced an example of duodenal ulcer operated upon in 1911, nineteen years ago, by a modified long-loop gastrojejunostomy of the Roux type. In this case, there were so many adhesions around the duodenum and stomach and involving the transverse colon that I had to do an anterior gastroenterostomy, end-lateral jejunum to stomach, and end-lateral jejunum to jejunum. I performed it with a long loop, because I knew the risk of duodenal dilatation when Roux' method of a short loop is employed. (*Jour. Amer. Med. Ass.*, pp. 59-117, July 13, 1912.) After many years, during which the patient had been lost track of, the students in the follow-up squad finally located him as a motor man running cars past the hospital every day. He still has some discomfort after eating, especially later, when the stomach has emptied. I note this case in some detail in order to record and emphasize the difficulty

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of a real follow-up system. To be successful, it must be explained to the patient before he or she leaves the clinic and must begin within a year of their discharge.

Historical.—In reviewing this personal experience of more than forty years of intestinal suture, the surgeon responsible for its introduction, Theodor Billroth, of Vienna, still ranks first. Billroth No. I is an end-to-end suture, and Billroth employed single interrupted silk sutures (not mattress sutures), and three rows of sutures. Figure 1 is a copy of his original drawings, made almost fifty years ago. I know of no new principle since. The Billroth No. II operation (Fig. 11), resection of a portion of the stomach, in which the open end of the stomach was closed followed by gastro-

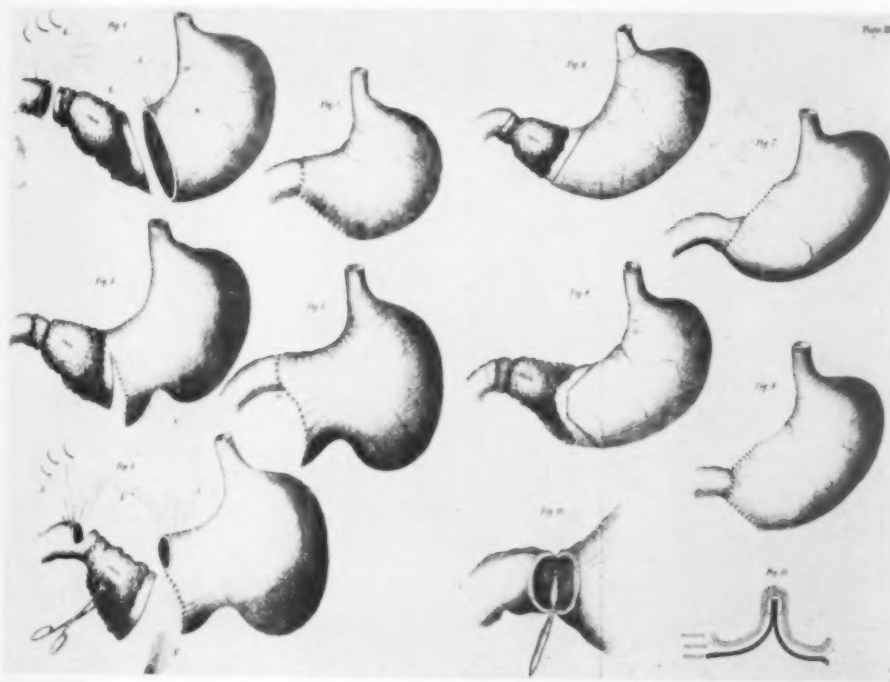


FIG. 1.—Copied from Billroth's Clinical Surgery, 1876 (see text pp. 3 and 16). Note the small cancer at the pylorus, the narrow margin given the cancer; the three rows of single interrupted suture; various methods of anastomosing duodenum to stomach. Compare Fig. 7 in the Billroth picture with our Fig. 6.

enterostomy of the lateral type, was forced upon those early operators, because so much of the stomach had to be sacrificed to give a suitable margin to the late cancer or ulcer. For many years Billroth No. I, end-to-end duodeno-gastrostomy, was neglected. The master minds in gastric surgery were trying to perfect gastroenterostomy. Kocher modified Billroth No. I by an end-lateral anastomosis (Fig. 2). L. Clarence Cohn, my associate (*ANNALS OF SURGERY*, vol. lxxix, p. 229, February, 1924), reviewed my personal experience with this method of anastomosis since 1910. Since that article was written I have personally changed from the Kocher to the Billroth No. I, because the latter could be performed with less tension than the Kocher, and

it was distinctly quicker. The immediate and permanent results, in my hands, have been identical. The only reason to choose Billroth No. I is that one needs less stomach and less time. The literature in the past five years shows that operators in every country are returning to the original Billroth No. I, end-to-end duodenogastrostomy. No modifications have changed the principles, or, as far as I am able to judge, improved the technic. The majority of operators, however, use a continuous suture of catgut, at least for the approximation of the mucous membrane.

In 1886, I witnessed Senn¹ perform lateral anastomosis on dogs, using decalcified bone plates to make the lateral anastomosis, either gastroenteros-

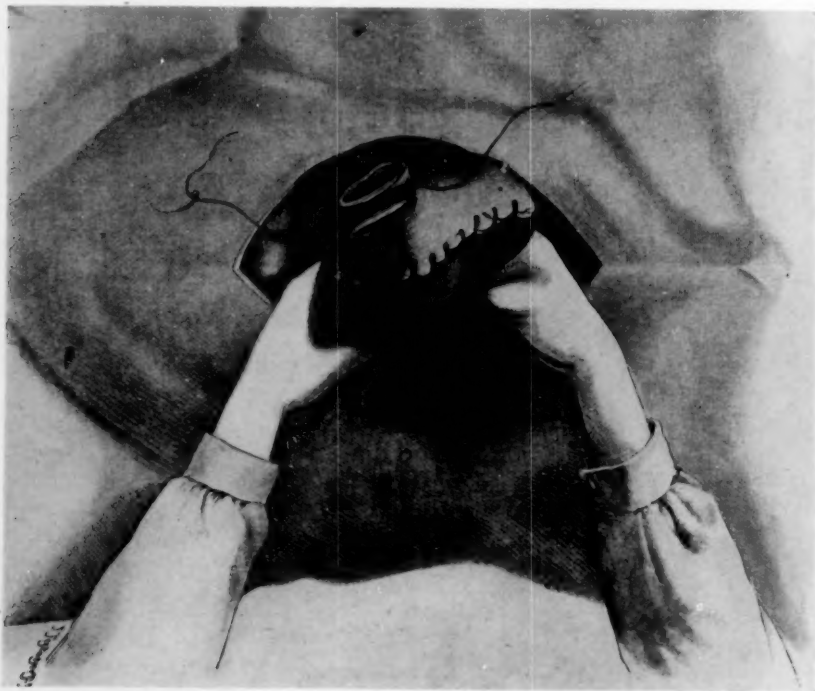


FIG. 2.—From Kocher's book on Operative Surgery, to illustrate Kocher's suture after resection of the pylorus. Resected end of stomach closed; duodenum sutured to posterior wall of the stomach, end-lateral. Note continuous suture. No statement as to silk or catgut. See text p. 3.

tomy, entero-enterostomy, or enterocolostomy. Senn was the first (I write from memory) of a group of experienced operators who tried to find a substitute for Billroth's end-to-end anastomosis between the duodenum and stomach and the lateral anastomosis between the stomach and jejunum. As a medical student in the University of Pennsylvania, between the years 1888 and 1891, in the physiological laboratory of Professor Reichert, my classmate, Doctor Heller, and I performed numerous experiments with intestinal su-

¹Nicholas Senn, Milwaukee (*Jour. Amer. Med. Ass.*, vol. xxi, p. 215, 1893). This reference is taken from Cyrus F. Horine, of the department of surgery in the University of Maryland (*ANNALS OF SURGERY*, December, 1922).

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ture on dogs. We found that a rubber tube of the drainage type made into a ring by invaginating one end into the other was just as effective as Senn's bone plate and much less difficult to prepare. I do not remember the name of Billroth being mentioned to us. I am quite certain that if we had seen his illustrations, we would have attempted direct suture.

John B. Murphy,² of Chicago, devised his button. In spite of its success, it is rarely used today. The majority of operators have returned to the suture methods of Billroth.

It seems remarkable now that such courageous and skilled operators of the type of Senn, Murphy and McGraw, should have introduced substitutes for Billroth's methods of direct suture.

When I came to Halsted's clinic of Johns Hopkins Hospital, in 1892, I was tremendously impressed with his methods of intestinal suture which he had worked out so beautifully in experiments on dogs and had practically perfected as a method of anastomosis on these animals before Johns Hopkins Hospital opened in 1889. It is important to record here that Halsted used a single row of mattress sutures, and each needle was made to catch the submucosa. The mattress suture not only approximates, but invaginates. The histological studies of sections through the anastomosis on the intestine in dogs showed almost perfect anatomical restitution. I assisted Doctor Halsted with his first gastroenterostomy. He had brought to the operating room reprints of his articles, so that we had before us his beautiful illustrations. The retrocolic route had been established, but little or no attention was paid to the exact length of the portion of the jejunum between the anastomosis and the duodenum, nor, as I remember it, to the direction. Halsted made his anastomosis exactly as he would on a dog, and, it seemed to us, as perfectly. This patient very quickly, on coming out of anaesthesia, began to vomit, and exhibited the symptoms of the then known and feared complication described as a "vicious circle." In forty-eight hours there were symptoms of peritonitis, and at the autopsy on the fourth day there was leakage. One of the stitches had torn out, perhaps due to the vomiting. I helped at this autopsy, but I did not look at the duodenum to see if it was dilated, or to demonstrate the kink as shown in Fig. 3. In the next few years, in Halsted's clinic, there were a few more operations in which a single row of mattress sutures was employed. In more than one-half of them there was leakage and peritonitis. I distinctly remember Doctor Halsted saying to me before 1895 that his experimental work on intestinal sutures in dogs was a failure when applied to man's intestine. Halsted's disappointment and chagrin made a great impression on me. In spite of this, Halsted will always be given credit for calling our attention to the importance of the submucosa as the layer in the wall of the gut through which the needle should pass. The mattress suture also has its place, providing it is reinforced by a second or third row of sutures. Finney has demonstrated this, because in his successful pyloroplasty the first

² Med. Record, vol. lxii, p. 665, New York, 1892.

row of stitches which catch the submucosa and not the mucous membrane are of the mattress type.

Horine (*loc. cit.*), in 1922, mentions 225 different methods of anastomosis and many of them in recent years were attempts to perform resection and suture without contamination. One of the last pieces of experimental work of Professor Halsted was his buttress principle in end-to-end anastomosis,

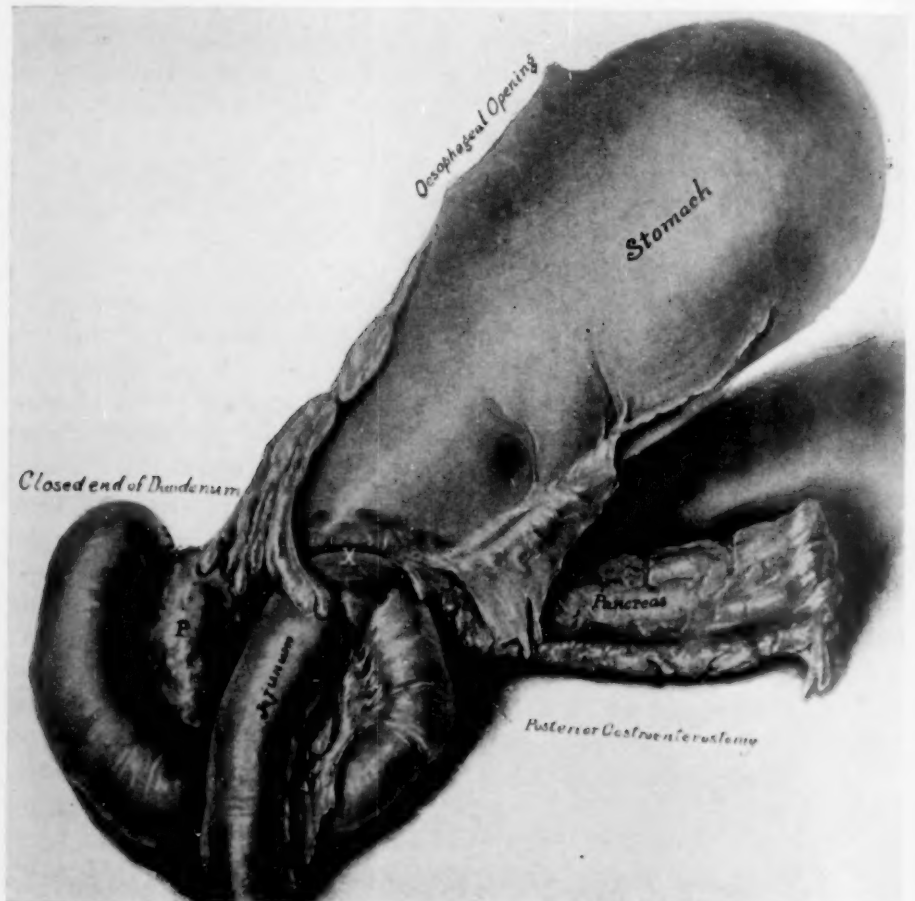


FIG. 3.—Pathol. No. 9871.—Photograph of autopsy specimen some months after resection for cancer with short-loop posterior gastroenterostomy (Billroth No. II). Note the partial kink at X and that the loop turns in the wrong direction, to the right. This anastomosis did not work well for some weeks, but acute dilatation of the stomach did not take place. This photograph illustrates the danger of any short-loop gastroenterostomy after resection.

and there have been many other attempts by Gatch and others. It is important to remember that Billroth not only did not use clamps, but paid no attention to slight contamination. In 1893, when I visited Vienna, I witnessed Billroth operate, and read his original contribution on gastric suture, I decided to follow his technic. For this reason I have rarely used clamps in resection and anastomosis and have, with rare exceptions, used three rows of interrupted suture as originated by Billroth, but I have substituted Hal-

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sted's fine black silk pre-operatively threaded on a fine straight needle, or a French curved needle. I have rarely employed the mattress suture, even in the Finney pyloroplasty; I have never neglected to try to catch the submucosa, at least in two rows of sutures. In recent years I employ, when indicated, the continuous catgut suture to approximate the mucous membranes. We have gone over these cases again and again, from year to year, and there is not a single death from peritonitis due to leakage, except in a few instances where we were forced (or at least thought we were forced) to substitute catgut for silk. One of these cases was a resection of the cardiac end of the stomach, and the suture of the pyloric end to the cesophagus. On account of tension and operative shock demanding haste, I used catgut throughout. The patient died suddenly on the fifth day. At the autopsy we found peritonitis from leakage at a point where one catgut suture had pulled out. Since then I have learned to mobilize the duodenum making the Billroth I method possible after even an extensive resection of the stomach. We are always prepared for transfusion to meet shock. In this case I should have placed interrupted silk at least as the last row of sutures and thus covered the first two rows of catgut by approximating the stomach to the diaphragm. If this patient had not died because of the leakage, it would have been one of the first successful cases of resection of the cardiac end of the stomach for an extensive cancer with an end-to-end anastomosis between the pyloric end of the stomach and cesophagus. It is my opinion that I missed an opportunity by breaking away from Billroth's original procedure of three rows of interrupted silk. I am also of the opinion that Halsted's fine needles and silk rank first in safest intestinal suture today, in spite of the fact that many experienced operators are obtaining excellent results with two or three rows of continuous catgut.

Gastroenterostomy and Finney's pyloroplasty.—Apparently the first type of gastroenterostomy performed in Billroth's clinic was anterior and with a long loop, and it seems to have worked well (Fig. 11). The oldest illustration I have of Billroth depicts an entero-anastomosis. Following this was one of the most remarkable adventures in perfecting an intestinal suture of the lateral type and a gastroenterostomy, either after resection of the stomach for cancer or ulcer, or because of an inoperable cancer or ulcer, and, later, as an attempt to relieve or cure a duodenal ulcer. The first change in the gastroenterostomy was from an anterior one to a posterior, from antecolic to retrocolic. To perform an anterior anastomosis, whether ante- or postcolic, required a longer loop. The moment operators conceived the shorter route through a bloodless rent in the mesocolon, the loop became shorter and shorter, and the posterior wall of the stomach more accessible.

When I began to read the literature in 1893 and later to perform the operation, I was impressed most with the methods of Moynihan, of Leeds, England, and of William Mayo, in this country. I believe we owe to these two surgical geniuses the perfection of the short-loop retrocolic, posterior gastroenterostomy, and I have just had the opportunity to observe one of my

own gastroenterostomies of this type made ten years ago. It has remained anatomically perfect.

As I read this literature and observe from the histories the recorded experience of my colleague Finney and my own, I am impressed that gastroenterostomy after resections of the stomach gave more immediate trouble and less remote trouble than gastroenterostomies without resection where the pylorus was patent. Here the perfection of the technic of Mayo and Moynihan practically obviated the immediate complication, but could not protect against subsequent formation of ulcer at the site of the anastomosis or the recurrence of the symptoms due to the gradual closure of the anastomosis. I remember distinctly that both, Doctor Finney and myself, looked upon a gastroenterostomy as an operation of necessity and not of choice. This undoubtedly influenced Finney in the conception and execution of the now well-known and well-established Finney pyloroplasty. From a historical standpoint, I would place Finney next to Billroth as the second great contributor to new methods in gastric surgery to be followed by Moynihan and Mayo because of their perfection of posterior gastroenterostomy. Then would come Polya and Balfour, because Polya's is now accepted as the best method of gastroenterostomy after resection of the stomach, and Balfour has made it safer by lengthening the loop, whether it is performed by the anterior or posterior route. The long loop, as shown first in Billroth's antecolic anterior gastroenterostomy (Fig. 11), practically avoided the great danger of duodenal dilatation.

Duodenal dilatation.—In November, 1907, when I published my article on acute and chronic dilatation of the duodenum, I was not familiar with the great danger of this complication when gastroenterostomy was performed with a short loop after resection of the stomach, and that most of these cases died, within five days, a duodenal death. But in the *Journal of the American Medical Association* for July 13, 1912 (pp. 59-117), I discussed the great danger of duodenal dilatation and its fatality if there was any fault in the gastroenterostomy after resection of the stomach, and the chief cause of the kink was a short loop between the anastomosis and the duodenum, unless one fixed the stomach so that the anatomical positions would be maintained after operation, and not changed by rotation of the stomach, as shown in Fig. 3. The development of the Polya anastomosis and Balfour's modification proves this, although apparently those surgeons who were instrumental in the various modifications did not grasp the significance of duodenal dilatation.

What do the ultimate results indicate?—The immediate death after all forms of gastric surgery has practically been eliminated. No matter how sick the patients are before operation, or how anæmic, by better methods of anæsthesia and by blood transfusion, we are able to select the operation best for the lesion of the stomach irrespective of the condition of the patient. Now and then the operation may have to be done in two stages, but very rarely, in this country, is preliminary jejunostomy performed. Peritonitis

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due to leakage, like death from shock, has practically been conquered by proper methods of suture. Nevertheless, the least danger after resection of the stomach seems to threaten when Billroth No. I end-to-end anastomosis is performed and when the Finney pyloroplasty is selected as a routine, if possible, instead of a gastroenterostomy. In spite of the remarkable success of the Polya-Balfour type of gastroenterostomy and the retrocolic short-loop posterior gastroenterostomy for duodenal ulcer, I am impressed, in studying the immediate and permanent results, that Billroth No. I, or the Kocher resection and Finney pyloroplasty, are methods of choice, while the others are methods of necessity. I venture to suggest, as based on personal experience, that for duodenal ulcer of a character forbidding Finney pyloroplasty, resection of the pyloric end of the stomach with the duodenal ulcer, followed by Billroth No. I anastomosis, be selected instead of posterior gastroenterostomy.

As to permanent results, I have before me resections of the Billroth No. I type, of the Kocher modification, resections with gastroenterostomy all the types, anterior and posterior including the Roux method, which we performed previous to the Polya and Polya-Balfour. There are also two ten-year cases of the Polya-Balfour type. Of all of these cases, we have X-rays of the stomach, and we know clinically that the function of the stomach is just about as good as that of the average individual of the same age who has not been subjected to operation. The function of the stomach is sufficient for enjoyment and proper nourishment. So far the only late risk is a possible peptic ulcer in the position of the gastroenterostomy, especially of the short-loop type.

If the patients live more than five years, the results seem to be the same whether the resection has been for cancer or ulcer, or for a few examples of gastropptosis.

The relation of gross and microscopic pathology to gastric surgery.—Palpation of the mass in the stomach may not distinguish the benign from the malignant lesion, but palpation by one experienced in diseases of the stomach will very quickly differentiate the mass that is suitable for resection with some chance of a cure if it is malignant. Without much doubt the easiest conclusion to make is whether the mass is resectable or not. The more difficult decision is whether resection should be attempted when the cure of cancer is practically ruled out for the reason that it promises the cancer case more comfort for the time the patient has to live than a gastroenterostomy, and the ulcer case a better chance for a permanent relief.

The removal of a gland near the stomach or in the omentum for immediate microscopic study does not exclude cancer if there is no metastasis, and does not contraindicate resection if there is metastasis. I have always followed the rule formulated more than twenty-five years ago by surgeons of the greatest experience—that resection of the stomach for malignant disease, if possible, offers the patient more comfort and perhaps lengthens the lives even when there is metastasis to the glands or to the liver. In some

instances it is justifiable to run the risk of increased operative mortality in order to obtain this greater comfort, even justifying resection of pieces of the pancreas and liver. In cases of this kind one can establish the exact diagnosis at once by excising a piece of the tumor, when there are no definite metastatic nodules for study.

Now that we have blood transfusion, I have personally extended the indications for resection in ulcer adherent to the pancreas or even to the liver. In the first place, you can establish the diagnosis by frozen sections. In ulcer there is often a line of cleavage which allows separation not present in cancer. This is especially true of large, adherent duodenal ulcers where resection is difficult due to adhesions to the pancreas and the jeopardy to the common duct. In cases of this kind resection offers so much more than gastroenterostomy for a permanent cure that in some instances it is justifiable.

I am convinced that skilled surgeons will improve their results in gastric surgery if they would personally study in detail the gross pathology of the specimen which they remove. It has helped me. In the first place, the careful post-operative pathological study will teach surgeons that it is unnecessary to give the cancer of the stomach so much margin, and the ulcer of the stomach may be given even less margin. This allows resection with a Billroth No. I anastomosis which today seems to be the operation of choice. In my clinic at St. Agnes, where the number of gastric cancers is relatively small, in the past two years we have been able to resect all the gastric carcinomas and then do a duodenal gastrostomy as first performed by Billroth. This knowledge of the gross pathology also encourages the operator to enlarge the field of resection for both cancer and ulcer. In recent years the number of the benign tumors of the stomach, especially of polypoid tumors, is increasing. A surgeon with pathological knowledge will be able to recognize these lesions.

The most difficult pathological problem is to distinguish the earliest stage of cancer in ulcer. On this decision hangs the percentage of five-year cures. After von Mikulicz's death, a re-study was made of his large material of gastric cancer in ulcer with the conclusion that quite a fair proportion of the lesions, diagnosed cancer and subjected to resection, were ulcers, and, of course, all of these cases had been included in the five-year cures. There will be border-line lesions in every organ until we have a differential stain for the malignant or cancer cell. Nevertheless, the study of the microscopic sections of the five-year cures in many clinics of this country is absolute proof that there have been some permanent cures after resection of the stomach for cancer. I have one such case now living twenty years since the operation. Every pathologist who has examined the section agrees to the diagnosis of cancer.

The next pathological problem is whether the microscopic study of sections helps us in proving whether cancer develops in ulcer. I do not believe that any pathologist will disagree with the statement that cancer does develop in ulcer of the skin and oral cavity. But you cannot prove it, or

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you can prove it, by microscopic interpretation just as decidedly as in ulcer of the stomach. Yet many pathologists are of the opinion that cancer rarely develops in ulcer of the stomach. This controversy which has often been unpleasant has detracted from, rather than added to, our progress in the control of cancer of the stomach.

SOME ILLUSTRATIVE CASES. (*Billroth No. I.*)—In the first place, I am reproducing an illustration from Billroth's Clinical Surgery, published in 1876. In this the various diagrams picture a cancer of the pylorus (Fig. 1). Note the significance of the small tumor. This is the type that Kocher, after twenty-five years of experience, found to be the most frequent among the five-year cures—freely movable, small masses at the pylorus. Note the small margin given the tumor by Billroth. My five-year cures had no larger margin. Note the absence of clamps. Note the various types of end-to-end anastomosis between duodenum and stomach. How beautifully are pictured the interrupted silk sutures in three rows! I question if there has been any improvement in the conception or execution of this operation upon the stomach since Billroth. Although the literature is before me now as I dictate, I will not take the space in this preliminary report to discuss it. But I will simply emphasize again that the trend of recent surgery is towards Billroth No. I. It can easily be combined with the complete excision of the glands along the lesser and greater curvatures, and by mobilization of the duodenum, one can almost suture the duodenum to the œsophagus, if necessary. I have no evidence and I can find no evidence that removal of the glands along the lesser or greater curvature of the stomach accomplishes a cure when they are involved. Now that our technic is so safe there is no objection to trying it.

CASE I.—Pathol. No. 5437. Operation in 1904. *Resection for ulcer of the lesser curvature.* Suture Billroth No. I. Well in 1930.

Figure 4 shows an X-ray of the stomach of this patient (Lachner) taken by my colleague, Doctor Kahn, March 18, 1930. The patient has had no symptoms since his operation twenty-six years ago. You will observe there is no duodenal cap between the stomach and the duodenum, and it is a much more normal picture than after a Finney pyloroplasty or a Kocher. This case was reported in detail in the Johns Hopkins Hospital Bulletin (vol. xv, No. 164, November, 1904). Figure 5 pictures the ulcer on the lesser curvature, the dotted lines, the area resected without clamps. Figure 6 is a diagram of the sutured lesser curvature of the stomach and the gastro-duodenostomy. Dr. William A. Fisher, then resident surgeon of the Union Protestant Infirmary, assisted me. The sutures were made with fine black silk and fine straight Halsted needles. We inverted so much in the end-to-end suture that very little passed through into the duodenum for ten days. Figure 7 shows the typical gross ulcer. It was microscopically benign. I am inclined to think it pictures an acute ulcer of the stomach which would have recovered under rest and ulcer treatment. The patient, a white male, aged thirty-three, had had symptoms for only three weeks—constant, distressing, epigastric discomfort and watery vomiting at night. This man worked in the hottest furnace rooms at Sparrows Point near Baltimore. He has been in the same environment since the operation, and there has been no recurrence of the symptoms. It is natural to ask the question whether this resection, changing hyperacidity to hypo-acidity, has protected from recurrence of the ulcer.



FIG. 4.—Pathol. No. 5437.—Case 1. Text, p. 6. X-ray by Doctor Kahn, twenty-six years after resection of the stomach for ulcer with Billroth No. I anastomosis. Note silver wires in right rectus incision. Note the new pyloric ring without cap. Duodenum seems dilated. Patient free from symptoms.



FIG. 8.—Pathol. No. 10763.—X-ray by Doctor Kahn, April, 1930, twenty years after resection of stomach for freely movable cancer of pylorus, with Kocher anastomosis, as shown in Fig. 2. Compare this with Fig. 4. X-ray after resection Billroth No. I. Patient free of gastric symptoms, holds weight.



FIG. 6.

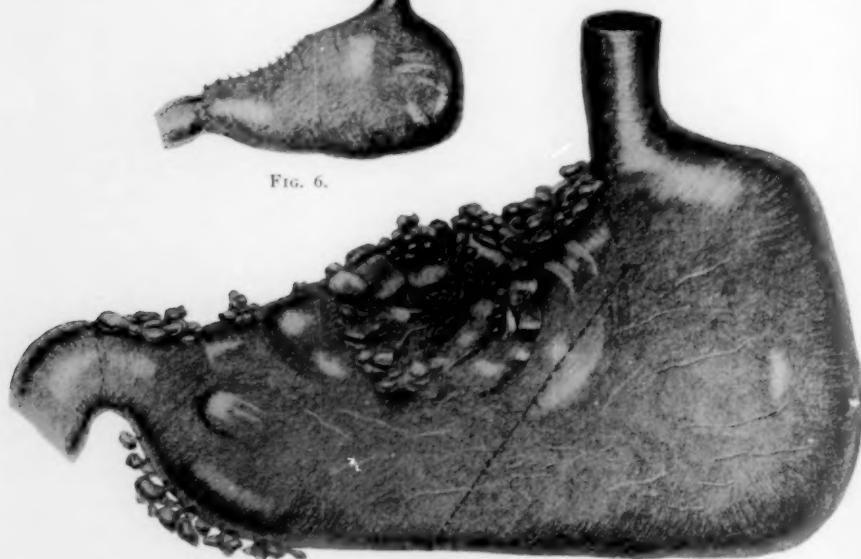


FIG. 5.

FIG. 5.—Pathol. No. 5437.—Sketch by Miss Hayes of position of ulcer resected through dotted lines in 1902. See Fig. 6 for Billroth No. I suture, and Figs. 7 and 7A for gross appearance of ulcer.

FIG. 6.—Pathol. No. 5437.—Sketch of suture (Billroth No. I) after resection shown in Fig. 5. See text, p. 17.

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CASE II.—Pathol. No. 39150. Resection Billroth No. 1, April, 1927. Well, May, 1930. three years.

This case was fully reported with illustrations in the *Practice of Surgery*, edited by Dean Lewis (vol. vi, ch. 8, Figs. 25 to 29, pp. 88 to 92). This man has perfect gastric function. There are two very important observations in this case. In the first place, when this patient was studied clinically and the mass in the upper abdomen palpated and the X-ray plates studied, in the greatest gastric clinic of the world, the diagnosis was "inoperable cancer of the stomach," and even exploratory laparotomy was decided against. Nevertheless, at the operation, I found a freely movable mass, much larger than a man's fist. But the stomach was large and almost two-thirds of the gastric portion of the stomach free of disease. The mass was easily resected. The next most important point is the narrow margin we purposely gave the new growth. There was no difficulty in performing a gastro-duodenostomy (Billroth No. I). No clamps were employed. The

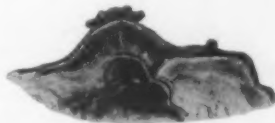


FIG. 7A.



FIG. 7.

FIGS. 7 and 7A.—Pathol. No. 5437.—Painting of actual specimen removed as shown in Fig. 5, mucous membrane surface showing ulcer with distinct sharply cut edge. The depth of the ulcer is shown in Fig. 7A.

entire suture was performed with fine silk—three rows interrupted. The gross specimen shows the abrupt ending of the cancer. Microscopically, it was a low-grade colloid cancer.

I explored the abdomen, because my studies of gastric cancer and ulcer have demonstrated that the only definite hopeless signs are nodules in the abdominal wall and free fluid in the peritoneal cavity. All other signs are not positive. This is not the first case apparently inoperable from the X-ray and palpation that we have been able to resect, but it is the first patient to live so long after operation.

Gastro-duodenostomy: Kocher's anastomosis.—The only surgeon whom I have seen perform Kocher's anastomosis was Dr. William J. Mayo. My associate, Dr. L. Clarence Cohn, has reported our experience with this method of resection and suture in the *ANNALS OF SURGERY* for February, 1924. This operation was first performed by us in 1910, and since 1924 we have changed back to Billroth No. I. Doctor Cohn illustrates the photo-

graphs of the gross specimen and microscopic appearance of a cancer at the pylorus resected by me at St. Agnes Hospital in 1910. This patient is living and free from symptoms in 1930.

Figure 8 (Pathol. No. 10763) is an X-ray taken by my colleague, Doctor Kahn, of this patient (Mr. Eakle), in April, 1930. It should be compared with Fig. 4, a post-operative X-ray twenty-six years after a Billroth No. I, and you will see that it is almost identical with Fig. 9; an X-ray ten years after a resection of the pyloric end of the stomach and a Kocher anastomosis. And these figures, 4, 8 and 9, should be compared with Fig. 10, a post-



FIG. 9.—Pathol. No. 12058.—X-ray ten years after resection of pylorus for chronic duodenal ulcer followed by Kocher's anastomosis. Compare with Fig. 8, same type of anastomosis after resection for cancer. Both patients have no gastric symptoms. See text, p. 21.



FIG. 10.—Pathol. No. 24026.—X-ray September 25, 1924, five years after resection of cancer of the greater curvature near pylorus. Compare with Figs. 4, 8 and 9. The duodenal shadow is different. The patient is free of symptoms. See text, p. 20.

operative X-ray six years after resection and Kocher anastomosis. Why does Fig. 10 look different from Figs. 8 and 9? The operation in Figs. 8 and 9 were identical—both resections of the pyloric end of the stomach. The lesions removed in Fig. 8 was cancer, in Fig. 9 a chronic duodenal ulcer, while the lesion in Fig. 10 involved the greater curvature of the stomach, so that the resultant form of the end of the stomach anastomosed to the duodenum was different from that in Figs. 8 and 9.

Pathol. No. 24026.—See Fig. 10. This case is the first, or one of the first five-year cures after resection of a cancer involving the greater curvature of the stomach near the pyloric end of the stomach. It is now eleven years since the operation, and the patient is free from symptoms. As a cured case of resection for cancer of the stomach, it is apparently unique in the fact that the cancer was adherent to the abdominal wall, and a large piece of the abdominal wall was excised with the tumor. The local pain and

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tenderness referred to the left and below the umbilicus at the point of adhesion of five months' duration, was apparently responsible for bringing the patient earlier to the attention of Doctor O'Mara, chief of the medical clinic at St. Agnes Hospital. There were no other symptoms, except nausea before meals, relieved by food. The glands, although enlarged, showed no metastatic cells.

Mr. George Thompson, member of the third-year medical class of Johns Hopkins University, a research student of the Garvan Experimental Fund in the Surgical Pathological Laboratory of the Johns Hopkins Hospital, has written to, and seen, every patient recorded in the laboratory living today whose operation has been either a Kocher or a Billroth No. I after resection for cancer, gastric or duodenal ulcer, and in every instance, clinically, the patients are free from symptoms irrespective of the pathology of the lesion which had indicated the operation. As stated before, we found the Billroth No. I suture just as safe as the Kocher, and Billroth No. I can be performed when Kocher would be difficult on account of the size of the remaining stomach.

I call attention to a small group of chronic duodenal ulcers, usually posterior and adherent to the pancreas, absolutely unsuitable for the Finney pyloroplasty, or any form of gastro-duodenostomy, which were not relieved by a posterior gastroenterostomy. In my limited experience, these cases are permanently relieved by resection, even with a portion of the pancreas, and a Kocher or Billroth No. I anastomosis. Figure 9 is an example of such a case.

Billroth No. II: gastric resection with gastroenterostomy.—Figure 11 is a photograph from an illustration in Billroth's Surgery made more than forty-five years ago. It pictures the long loop, anterior gastroenterostomy with an entero-enterostomy. Notice, in this picture, the unnecessary margin of uninvolved stomach given the tumor in this case. Compare it with Fig. 3, a photograph of a modern short-loop, posterior gastroenterostomy. I have already discussed that the short-loop gastroenterostomy of any type after resection of a portion of the stomach with a closed duodenum, runs, first, the risk of death due to duodenal dilatation; second, the risk of a partial kink from which there is no complete recovery until to the gastroenterostomy is added entero-enterostomy; and, third, secondary peptic ulcer at the anastomosis. I have before me now cases of five or more years' duration in which the operation was resection with Billroth No. II and a short loop. It is in this group that I find a certain per cent. of the three complications just mentioned—complications which we have never observed after resection of the stomach followed by a Kocher or Billroth No. I anastomosis. True, there have been some perfect results in which there have been no complications seventeen and nineteen years after operation. Since that date, 1913, I have practically given up a short-loop gastroenterostomy of any type after resection of a portion of the stomach, and in the few cases that I have been

unable to perform the Billroth No. I, the Polya method as modified by Balfour has been used with excellent results.

In the Practice of Surgery, edited by Dean Lewis (vol. vi, ch. 8, Fig. 1) there is illustrated the case of a huge ulcer of the stomach, the largest we have ever resected, in which the patient is free from symptoms today twenty years after resection and a Billroth No. II anastomosis.

Gastro-jejunostomy: Roux type.—About twenty-two years ago I performed a huge resection of the stomach for ulcer. At operation I could not be certain whether it was ulcer or cancer. There was no particular difficulty in the resection, but the remaining cardiac end of the stomach was so

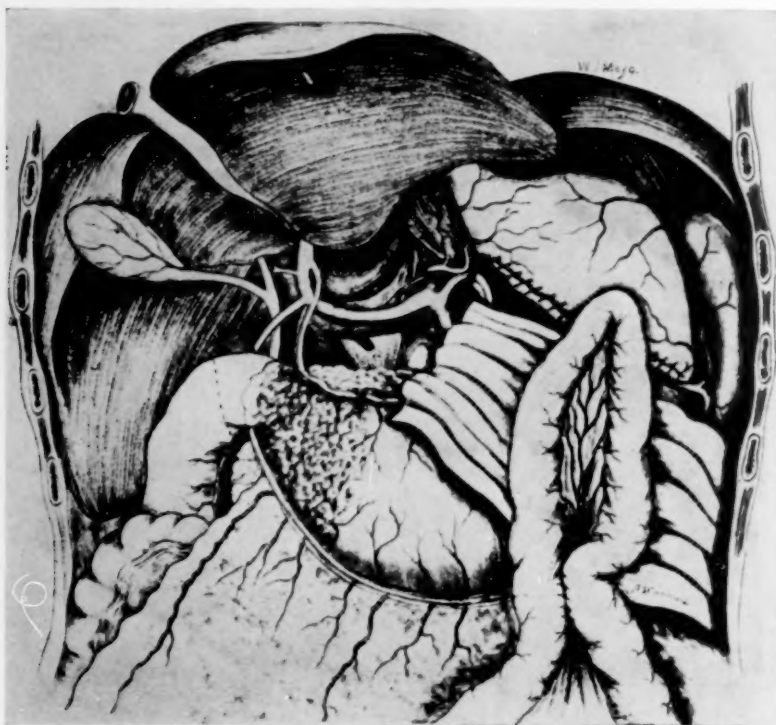


FIG. 11.—Copied from Billroth's Clinical Surgery, 1876. Reproduced by William J. Mayo to illustrate long-loop antecolic anterior gastroenterostomy with jejuno-jejunostomy. Note continuous suture instead of interrupted shown in Fig. 1; wide margin of uninvolved stomach wall as compared with narrow margin in Fig. 1. From this sketch it is my opinion a narrower margin would have allowed a Billroth No. I anastomosis.

small that I did a short-loop gastro-jejunostomy, Roux type, retrocolic. There would have been no difficulty whatever in performing the long-loop anterior gastroenterostomy, as pictured in Fig. 11. This patient died of acute dilatation of the duodenum. In 1911, I was confronted at operation with what was apparently a duodenal ulcer with such extensive adhesions that it was impossible to lift up the transverse colon and perform a retrocolic anastomosis. I therefore chose a long-loop Roux gastro-jejunostomy, anterior. This patient is living and free of symptoms today, nineteen years later. I

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may be able to add the post-operative X-ray which shows both the pylorus and the anastomosis working.

Resection: gastroenterostomy of the Polya type.—I have before me two histories in which the operation was performed for gastric ulcer by my colleague, Dr. Emil Novak, at St. Agnes Hospital, seven and eight years ago. One patient operated on seven years ago reports well. The other patient writes, "I am not well, but at the present time I am not under the care of a physician." We do not know whether the symptoms she is suffering from have any relation to her former condition or the operation.

My first experience with the Polya-type gastroenterostomy was ten years ago. I followed exactly the directions of the author. The loop was more or less short and the anastomosis retrocolic. The patient died suddenly on the fifth day from embolism without gastric symptoms.

The second operation was performed in October, 1928, on a thin woman, aged eighty-two. The lesion was cancer at the pylorus, which had infiltrated the pancreas and could not be completely removed from the pancreas. This form of anastomosis was chosen because I did not wish to make a Billroth No. I gastro-duodenostomy over the raw surface of pancreatic tissue and cancer. In this second case, using Polya, I chose the modification of Balfour, of the Mayo Clinic, in which the loop is longer and the anastomosis is anterior. There has been recently reported from Sweden a peptic ulcer following this method of anastomosis.

Posterior gastroenterostomy without resection of the stomach for gastric ulcer.—Apparently Doctor Finney and myself agree that any form of posterior gastroenterostomy without resection is an operation of necessity and not of choice.

I have never seen death from acute dilatation of the stomach after gastroenterostomy of any type, even the short-loop posterior. But every surgeon knows that it may fail to cure the gastric or duodenal ulcer. In a few instances, especially when the operation is badly done, it may lead to chronic dilatation of the duodenum which may be relieved by duodeno-jejunostomy as a secondary procedure. I will take this opportunity to quote a few cases of successes and failures.

Pathol. No. 8923.—I explored the abdomen in 1908, twenty-two years ago, because of symptoms we thought then typical of gastric ulcer. No ulcer was found; the gall-bladder was drained. Seven months later the patient returned with even more exaggerated symptoms, and at the second operation we found a large indurated mass in the lesser curvature of the stomach adherent to the liver, suggesting walled-off perforation. There were no signs or symptoms of obstruction at the pylorus, at either operation. In 1914, five years later, at an operation for ventral hernia, all the evidence of gastric ulcer had disappeared. The posterior gastroenterostomy was working.

Pathol. No. 9174½.—*Posterior gastroenterostomy* at St. Agnes Hospital in 1909, twenty-one years ago, for gastric ulcer. Symptoms were absolutely relieved. The clinical picture before operation suggested chronic cholecystitis. The gall-bladder attacks had been present over two months; jaundice in one attack. There was gastric residuum 136 cubic centimetres; total acid 32°; free hydrochloric acid 32°. At the operation we found

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on the anterior side of the pylorus midway between the greater and lesser curvature a distinct dimpling of the peritoneum with a zone of induration the size of a fifty-cent piece beneath. The pylorus was patent and the stomach not dilated. The indurated area extended in to the duodenal wall. There were adhesions between the duodenum, stomach and gall-bladder. This patient writes that he has been completely relieved of all symptoms for twenty-one years. I am inclined to the diagnosis of duodenal ulcer.

Pathol. No. 10778½.—*Posterior gastroenterostomy, short loop, for extensive gastric ulcer with adhesions.* The patient is well in 1930, nineteen years later. She was relieved at once. At the operation we found a huge stomach, marked induration of the pyloric end of the stomach extending into the duodenum with adhesions to the gall-bladder. The operative diagnosis was ulcer rather than cancer. Had it been cancer it would have been inoperable. There was a long history of indigestion with partial gastric obstruction; an operation two years before with drainage of the gall-bladder.

I asked Mr. Thompson to simply gather for me the patients who were living five years or more after any operation for gastric or duodenal lesions, and I have mentioned only one or two in which the operations were less than five years ago. I have not taken up the total number of operations in each group, because I wished to present the picture from cases living, irrespective of disease, operation or present result. With few exceptions the fact is brought out that if they live five years or more they are free from symptoms.

That Mr. Thompson could find but three cases of short-loop posterior gastroenterostomies for gastric ulcer living five years or more after operation, simply shows that I rarely perform this operation for gastric ulcer, always trying resection if possible. But these three cases demonstrate that posterior gastroenterostomy can be performed and the patient live seventeen years or more, apparently relieved of their symptoms and not given any discomfort by their gastroenterostomy. Only the first case was a positive gastric ulcer; the second may have been a duodenal ulcer. The picture in the third case was confused by the previous operation.

There is quite a large number of gastroenterostomies for inoperable cancer that were temporarily relieved, irrespective of the type of the anastomosis, but none lived five years.

Posterior gastroenterostomy for duodenal ulcer.—The majority of surgeons choose this operation, and the results are uniformly good. Very few surgeons select a group for the Finney pyloroplasty. When I compare my own results I find that I have had the same satisfactory relief after both, the Finney pyloroplasty and the gastroenterostomy for duodenal ulcer, except in cases unsuitable for the Finney operation, but with extensive adhesions and a posterior ulcer adherent to the pancreas. And as I have practiced resection largely in this type, the operative results for duodenal ulcer have been uniformly good. I will briefly review these successes and failures here.

Pathol. No. 17044.—*Short-loop posterior gastroenterostomy for duodenal ulcer in 1915.* Relieved of symptoms and well in 1930, after a period of fifteen years. This adult male, aged fifty, had had symptoms fifteen years. He was under continuous and efficient medical treatment by Doctor Mizell, of Atlanta, Ga., for three years. The marked symptoms are periodic recurrent attacks of pain, indigestion relieved by induced vomiting and lavage. Before seeing the pylorus I could feel that it was obstructed and could palpate

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the induration on the duodenal side. Pylorus, gall-bladder, pancreas, transverse colon were bound into one mass which was hard. I could not tell whether it was cancer or inflammation. As it seemed chiefly duodenal, duodenal ulcer seemed the reasonable diagnosis, and posterior gastroenterostomy not only the operation of necessity, but of choice. The adhesions were entirely too extensive to justify resection, even today, with my accumulated experience of fifteen years. This patient was immediately relieved, and yearly reports from Doctor Mizell read as follows: "Yes, well, except for some duodenal or pyloric irritations from coarse food which he eats at occasional periods."

Pathol. No. 17640.—*Posterior gastroenterostomy for duodenal ulcer* in 1915. The patient writes that he is well in 1930, fifteen years after operation. I performed this operation with Doctor McQueen at his hospital in Charlestown, W. Va. The symptoms had been present twenty-one years and were typical. They were complicated by the excessive use of alcohol. At the operation, the omentum and greater curvature of the stomach on the pyloric third of the stomach were adherent to the liver for a distance of seven centimetres to the left of the notch. This pulled the stomach up. When we had separated these adhesions, we found the gall-bladder adherent. Finally we exposed the pylorus and duodenum. The pylorus was not contracted. On the anterior side of the duodenum, in about the second portion, there was an indurated mass which was the centre of all the adhesions, and every one contracted to this point. It was about the size of the end of the index finger. It was near the common duct. (Twelve years ago there had been an attack with jaundice.) We separated only enough adhesions to make certain of the duodenal ulcer and that a Finney pyloroplasty or resection was too difficult for the operation of choice. This patient was immediately and permanently relieved in spite of the fact that the alcohol history remained about the same.

Pathol. No. 17722.—Fifteen years ago, at St. Agnes Hospital in 1915, this adult male was operated upon by a posterior retrocolic gastroenterostomy for duodenal ulcer, and was immediately and permanently relieved up to date (1930). At first there was no palpable or visible duodenal ulcer. There were no adhesions, but the peritoneum over the duodenum and above the pylorus was covered with scar tissue extending to the common duct and gall-bladder. The pylorus was slightly contracted. The absolute position of the ulcer could not be found. These findings made the Finney pyloroplasty unsuitable and seemed not sufficiently marked to justify resection and Billroth I. This man, aged twenty-eight, complained of symptoms of indigestion for six months. They began on an empty stomach and were relieved by food, but the relief was only temporary. He was underweight and when carefully questioned complained that he had had a bad appetite for five years since emigrating from Ireland to this country. Then he admitted attacks of indigestion for many years. In the last six months there have been attacks of vomiting of blood and blood in the stools.

In these cases I am not discussing the X-ray studied before and after operation, taking space to emphasize the relation between the operative result and the pathology, and the duration of the symptoms.

Pathol. No. 17774.—This male, aged fifty-five, had had recurrent abdominal attacks for fifteen years, and the operation of posterior gastroenterostomy was performed in 1915. The patient and his doctor report him well in 1930. He was brought to Baltimore by Doctor Parker, of Greenville, S. C., and had been acutely ill for five days. He was operated on at once, because there were symptoms of perforation, but not of peritonitis. It is very important to note that this patient went through an efficient study by a surgeon and gastroenterologist five weeks before the perforation, and at that time was advised to go home with the statement that no operation was indicated. The diagnosis was not duodenal ulcer, but chronic appendicitis. When I opened the abdomen I could see blood in the small intestines. In the region of the duodenum, beginning at the pylorus and occupying a part of the first third of the duodenum, we could see fresh exudate extending over the pylorus, duodenum to liver, and within this a palpable mass. I felt it unwise to disturb this area as it suggested a walled-off perforation and, undoubtedly, had we

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exposed the perforation, it would have been difficult to suture. For this reason we drained to this area, and performed a posterior gastroenterostomy.

On opening the stomach and jejunum I found bile and blood. After operation there was no further bleeding. When the drains were removed there was no evidence of perforation or abscess.

Pathol. No. 20746.—This was the first woman among these five cases of posterior gastroenterostomy to be immediately and permanently relieved of definite duodenal ulcer. The patient was fifty-seven years of age, having had definite symptoms for fifteen years. The frequent vomiting suggested pyloric stenosis. She had lost one hundred pounds of her two hundred forty pounds of weight. There had been no bleeding. The X-ray was typical of stenosis. At the operation, a film of scar tissue covered the duodenum and pylorus, binding it down. There was also the same scar tissue between the duodenum and the gall-bladder. The pylorus was almost closed. It seemed unsuitable for a Finney pyloroplasty. Her physician, Doctor Wagaman, of Hagerstown, Md., writes in 1930 that the patient is well.

It is to be noted that in none of these five cases was the pathology suitable for a Finney pyloroplasty, nor did it seem justifiable to try resection.

These results after posterior gastroenterostomy for gastric and duodenal ulcer should be borne in mind. There is no doubt that in every clinic among operators who understand this operation immediate and permanent relief can be obtained if the cases are properly selected, and even when resection does not seem feasible or proper at the first operation because of the added risk, posterior gastroenterostomy can be done first and the patient carefully watched. If not relieved, resection can be attempted later.

Pathol. No. 23791.—*Apparent failures after posterior gastroenterostomy.* In this instance the posterior gastroenterostomy performed in 1918 for chronic duodenal ulcer in which there was a mass adherent to the pancreas, failed to completely relieve the patient. Twelve years later, in 1930, the patient came under observation and claimed that he had never been relieved of his symptoms. We found that the anastomosis was practically closed and as there had been no active symptoms and no hæmorrhage, only indefinite attacks of indigestion, and as the X-rays showed a patent pylorus, we simply detached the jejunum from the stomach, because it was of no value, and had a minute peptic ulcer at the side of the opening which would not admit the little finger. The adhesions noted at the first operation twelve years before seemed to be less. We could see the pylorus and duodenum. The pylorus was patent. I apparently overlooked at the second operation the mass in the posterior wall of the middle third of the duodenum adherent to the pancreas. This operation was on November 22, 1929. I operated upon this patient a third time on April 10, 1930, about four months later, as the operation had not relieved him of his discomfort and because there had been bleeding to an extent demanding three blood transfusions. The patient's condition was such that we selected a rapid anterior gastroenterostomy. This operation relieved the patient of his symptoms and the bleeding ceased, when suddenly on the fifth day he died with symptoms of embolism. An autopsy was not allowed.

A few months before and a few weeks after observing this failure of a posterior gastroenterostomy, I had similar cases who were in good shape at the time of operation and in which I resected a small piece of the stomach, the pylorus, the duodenum with its ulcer and a piece of pancreas, and then anastomosed the duodenum to the stomach by the Billroth No. I method. Both of these patients were relieved immediately and permanently by the

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operation. One of them who had tuberculosis at the time of the operation died some months later of tubercular pneumonia, which seemed to be due to an attack of grippe rather than a post-operative sequence. The operation was performed under local anæsthesia. There are other cases in this group which I will discuss in greater detail when I report Pathol. No. 23791. But this case stands out as a distinct failure of posterior gastroenterostomy to relieve a certain type of chronic indurated duodenal ulcer. Unfortunately this patient was of a peculiar mental disposition. None seemed to pay attention to his complaints, and he did not come back to see me until he was desperately ill. I am chagrined that I did not recognize that the chronic ulcer was still present, because at the operation in November, 1929, the patient's condition would have justified resection.

Pathol. No. 13505.—In this case it seemed to be the adhesions present before operation that kept the patient uncomfortable. The three operations for adhesions between November, 1912, and April, 1915, gave only temporary relief. The adhesions originally were apparently the result of a healed duodenal ulcer. In 1915, posterior gastroenterostomy was performed as a last resort. In 1923, the patient reported "no better" after a continuous observation of nine years. However, in 1930, seven years later, he reports well.

I find notes on about six cases in which the operation consisted of separation of adhesions around the gall-bladder and in which we could find no indication for removal or drainage of the gall-bladder, posterior gastroenterostomy or Finney pyloroplasty.

Pathol. No. 13505 represents the single failure among this group. Pre- and post-operative adhesions explain, in a certain number of cases, uncomfortable symptoms with and without obstruction which may follow any laparotomy. It is not a large group, but it is a very difficult one to handle. Time is an important element in recovery, and unless there are symptoms of obstruction or unless there is a definite hernia, they are better left alone.

Pathol. No. 25554.—Here is an example of a faulty gastroenterostomy performed under the diagnosis of chronic duodenal ulcer. This patient was relieved of her symptoms, of intermittent attacks of vomiting and continuous abdominal distress and ill-health which had been present fifteen years, by a duodeno-jejunostomy and resection of the right colon. It is now ten years since that operation. In the history, difficult to obtain, one gets the impression that this patient, when she was operated upon in 1905, had ptosis of the stomach and colon. The operation was performed by a surgeon of practically no experience in gastroenterostomy. She claims that there were three operations within a short period of time, and she was gradually getting worse in the fifteen-year interval. After a thorough study in 1920, with Doctor Freeman, we decided that her chief trouble was a faulty gastroenterostomy. The most marked feature was intense attacks of pain and vomiting.

When we opened the abdomen in 1920, we had to remove the adherent omentum before we could expose the region of the gastroenterostomy. In spite of the adhesions of the upper portion of the jejunum, we could make out that the posterior gastroenterostomy had been performed with a long loop, and there had been at least one entero-anastomosis. In spite of pre-operative preparation and starvation, some of these loops were still dilated. There had also been a suspension of the uterus which was not disturbed. The right colon was so bound down by adhesions that I felt that this right colon should be resected first. Then we brought to view the huge dilatation of the duodenum. A loop of jejunum, free from adhesions below the faulty gastroenterostomy and adherent loops, was anastomosed to the duodenum, later method. There was no difficulty whatever. We divided the peritoneum over the duodenum, made the anastomosis and then sutured the edge of the

peritoneum to the duodenum. Now the ileum was sutured to the transverse colon by the lateral method. The patient, today, ten years later, is not a perfectly healthy or well woman. She still has her intermittent headaches and nervousness, but her vomiting attacks have been relieved, and she has much less indigestion. In this instance, therefore, there was not only a faulty gastroenterostomy, but there was no evidence that there had been any indication for this operation.

Finney pyloroplasty.—My association with Dr. John M. T. Finney, both at Johns Hopkins and the Union Memorial Hospital, brought me in close touch with his new method of pyloroplasty. I could not find a single case in which the operation failed to relieve the patient. There have been no examples of re-operation or recurrence of symptoms. In 1926, I selected for the first case one in which heretofore I should have performed posterior gastroenterostomy. The ulcer was distinctly palpable, but the pylorus and stomach were so movable that there was no more difficulty in easily performing the posterior line of sutures than opening the pylorus, stomach and duodenum and demonstrating by finger and eye an ulcer about one centimetre in diameter. It was on the posterior wall of the first portion of the duodenum. It was excised with an endothermy needle down to the scar on the peritoneal side and then closed with interrupted silk in the mucous membrane and mucosa. Such ligatures different from the continuous silk and not buried are discharged spontaneously after ten to twelve days. This patient has remained well (1930) four years since the operation.

In 1929, I performed a second operation of this type which has so far been successful.

My first Finney pyloroplasty was in 1902. At that time there was much theoretical discussion about gastroenterostomy as a drainage operation, and that it should be performed at a point in the stomach where drainage would be best. This patient had a huge dilated stomach because of a ring contraction or hemosis, at the pylorus. He had been using a stomach tube for more than ten years, and had been a patient on the medical service of Johns Hopkins for more than four years. Doctor Corss, of Newport News, Va., asked me to come there to operate as the patient was starving to death and had reached ninety pounds. At the operation there were no adhesions, no signs of ulcer of stomach or duodenum. The Finney pyloroplasty did not answer the requirements for drainage at the most dependent part, but it seemed the simplest, quickest thing to do. The man was immediately relieved and has remained so ever since. He has gained in weight.

Doctor Finney, who has had a very much larger experience during these twenty-eight years, has made a full report which will appear in the Transactions.

Among the cases operated on by Finney, I know of only two unfavorable results—in one the operation was performed for chronic duodenal dilatation, and the patient died within five days of acute dilatation of the duodenum. *ANNALS OF SURGERY*, (vol. xlv, p. 736, 1907), reported again the *Journal of the American Medical Ass.* (vol. lix, p. 117, July 30, 1912). In the other

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case, after relief of some years by Finney pyloroplasty, there was recurrence of the symptoms and posterior gastroenterostomy was performed with relief up to the present time.

One who reads the literature, listens to the discussion by surgeons of experience, and studies his own cases critically, knows that today, in the majority of instances, if the surgeon is well trained and the operation selected which experience has taught us to select as based upon the operative findings, there will be a very low operative mortality and few failures. The chief failures will be in cancer, and the cause will be the disease and not the operation. I, however, wish to call attention to the fact that the operations which promise the least chance of post-operative troubles are resections of the Kocher and Billroth No. I type and the Finney pyloroplasty, or some type of gastro-duodenostomy, practiced by Horsley, of Richmond, and others.

Finney pyloroplasty, or some type of gastro-duodenostomy with resection of the ulcer, can be pushed too far, and one must learn when it is safer and more certain to either perform posterior gastroenterostomy or resection with Billroth No. I suture.

I have a case under observation now. The operation was performed by one of our most experienced surgeons. The patient has not been relieved. There is still some obstruction, the patient is underweight and unable to take sufficient food to gain weight.

Perforation.—As William Mayo states, the dangers of perforation and hæmorrhage have been exaggerated. Nevertheless, it is still possible. I have already noted in this paper an example, in which the patient was carefully studied by an unusually experienced surgeon and gastroenterologist and sent home, only to return within a week with a walled-off perforation. Ten years ago we were having a conference in my office and about eleven o'clock at night one of my associates, who had been in the laboratory for more than one year, told me about his digestive symptoms. There was nothing in them to suggest impending perforation or hæmorrhage, nor obstruction, but enough to arouse suspicion of an ulcer, probably duodenal, enough to justify immediate rest in bed and starvation diet, while studies were made to see if operation was indicated. He consented to go to the hospital in the morning. He arrived eight hours later with perforation and died in spite of immediate operation, because his stomach contents held the hemolytic streptococcus.

There are four duodenal perforations which have been free of symptoms sixteen to fourteen years after operation, without recurrence of symptoms, hæmorrhage, perforation or obstruction. In three cases the perforation was simply closed. All were apparently acute ulcers. In one the small chronic ulcer was excised. I have never, in free perforation of a duodenal ulcer, performed either the Finney pyloroplasty or gastroenterostomy, and there have been no re-operations.

Hour-glass stomach.—There is but one case in which five years or more have elapsed since operation. In this instance, in 1920, a band of adhesions

producing an hour-glass contraction between the mid and cardiac third of the stomach was divided, and the patient is apparently well today, ten years later. Here there was a distinct history of ulcer of the stomach. Apparently, the ulcer was at the lesser curvature, and during the acute stage the adhesions had formed.

CONCLUSIONS

I urge the more frequent choice of the Billroth No. I anastomosis after resection of the stomach, pylorus or duodenum. In resection for cancer, it is unnecessary to give the wide margin of an uninvolved wall. When Billroth No. II must be performed, I would urge a long-loop gastroenterostomy and would recommend Balfour's modification of Polya's operation. In duodenal ulcer the Finney pyloroplasty is the operation of choice, if local conditions allow it, with and without the local excision of the ulcer. When Finney pyloroplasty is contraindicated, there must be a choice between short-loop posterior gastroenterostomy and resection.

In large chronic ulcers of the duodenum, especially those adherent to the pancreas, I advise resection rather than posterior gastroenterostomy. Finney's pyloroplasty or any type of gastro-duodenostomy with local resection of the ulcer may be carried too far. In such cases either a posterior gastroenterostomy, resection and Billroth No. I should be the operation of choice. It is rarely necessary when operating for a perforated duodenal ulcer to do more than to close the perforation and drain. Do not diagnose inoperable carcinoma from palpation and X-ray alone. Give the patient the benefit of exploration, unless there are skin metastases or fluid in the peritoneal cavity. And even then, if there is obstruction, operation is indicated.

Postscript.—I wish to call attention to the importance of making X-ray pictures after all gastric operations so that we may learn the varying normal as shown in Figs. 4, 8, 9 and 10. Five years ago a patient of mine, upon whom ten years previously I had resected the stomach and performed a Kocher anastomosis and with this resected the right colon for ptosis, had symptoms of indigestion, and, as I was in Europe, went to one of our best gastro-intestinal clinics and was diagnosed cancer from the X-ray picture. His X-ray picture, as I recollect it, resembled that shown in Fig. 10. But so far we have been unable to find the X-ray taken at either clinic. The patient lived four years and died of flu-pneumonia. The resection of the stomach was performed because of stenosis from a kink and a huge dilated stomach. It relieved the symptoms. The indigestion which caused the X-ray was a temporary affair and had relieved itself before I saw the patient. I have reported this case on two occasions when we have discussed the treatment of ptosis of the stomach and colon. The patient represented the best result I have ever obtained in the operative relief of ptosis of the colon and stomach. Some operation was imperative on the stomach, because of pyloric stenosis. I chose resection rather than Finney's pyloroplasty simply to get rid of the huge dilated stomach which was in the way, and made resection of the right colon more difficult.

A FOLLOW-UP STUDY OF THE RESULTS IN SURGICAL THERAPY FOR GASTRIC AND DUODENAL ULCER

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IN THE study of a disease in which the etiology is not known, and therefore in which the consideration of the best of many forms of therapy is in a state of controversy one premise stands out clearly, viz., that effort should be concentrated on investigation of cause. But until such time as the cause is known and the resultant treatment established, the soundest method of approach in actual therapy must be based on honest evaluation of results obtained by present methods. This is only possible by follow-up study.

When one attempts a review of the mass of European literature one is impressed by the frequency of the expression of the opposite viewpoint, viz., emphasis on technical procedure and paucity of evidence of detail study of interval and late results. For example, recently there have appeared reports from two of the best-known European clinics as follows: The first, a report of over one hundred radical resections for ulcer with the note that "ninety-eight per cent. were entirely cured after three to fifteen years," but with no mention of the percentage of cases followed for three years, fifteen years or the twelve intervening years respectively; the second report presents over sixteen hundred radical resections with no follow-up results, but with the conclusion that it is the operation of choice.

To the surgical clinics of this country we are indebted for many valuable and carefully prepared reports on this phase of the problem, and thus it seems especially fitting that this association should have chosen for part of its consideration this year a discussion limited to follow-up facts.

The rôle which the writer will play in this discussion will be an humble one as the number of cases presented in this paper is not large, but the fact that the study is based upon his review of each follow-up visit, and that the results presented have been evaluated after careful observation based upon personal interviews with the patients and actual examinations in the follow-up clinic in 95 per cent. of the observations recorded, may justify its presentation.

Because of limited time, the results in but two types of surgical therapy will be presented here, viz., gastroenterostomy and partial gastrectomy for ulcer of the duodenum and stomach. These operations were performed by the members of the surgical staff of the Presbyterian Hospital in New York between the years 1916 and 1929, hence not the statistics of any one operator.

The cases presented include all of those in which the surgeon elected one of the two operations mentioned, regardless of the condition of the patient, operative risk or complications such as previous or active hæmorrhage, com-

plete pyloric obstruction, etc., but do not include the cases of acute perforation.

The operative mortality includes every case which died either as a direct or indirect result of operation and is extremely high, and this is not the result of operations performed by the younger and less experienced men, as it goes without saying that it is the spirit of the clinic that the older men assume the responsibility in the gravest risks. Pulmonary complications have formed a distressing percentage in operative mortality, especially in simple gastroenterostomy in this series.

To any student of the ulcer problem it becomes increasingly evident that in reviewing the results in any form of treatment whatsoever, be it ultra-conservative, such as medical, or any type of surgical procedure, one outstanding feature constantly presents itself in as yet intangible form, viz., the subtle effects of the constitution and temperament of the individual and his reaction to the stress and strain of his environment. This with the well-recognized tendency to recurrence either of symptoms or the disease itself has demanded the form of study here presented, viz., statistical follow-up results shown in their continuity.

Fortunately with the great majority of the patients concentrated within the small radius of a large community it has been possible to carry out the observations on individuals at six-month intervals and thus more carefully observe the fluctuations in the follow-up curve.

In addition, some five years ago the writer began a study of cases of ulcer treated medically on his surgical service by his associates and himself. This was done for our own education and that of our surgical staff, so that first-hand information could be obtained in the observation of these cases under our own conservative management and secondly, so that our background of the behavior of the disease and its response to treatment might be broadened. Admitting these cases to a surgical service for conservative treatment places them directly under our control, and they then can be subjected to the same rigid analysis as to interval results as are the cases treated surgically; and furthermore, when indication for surgery arises in this group, we have a more comprehensive knowledge of the individual and his form of medical treatment. The number of these cases must, of course, be limited at any one time on a surgical service.

Four hundred and thirty-five cases of ulcer, treated on the surgical service, have been reviewed, and of these, gastroenterostomy was performed in 119 cases and partial gastrectomy in seventy-six cases. We have established the presence of marginal ulcer in 6.9 per cent. of the gastroenterostomies and in 3.6 per cent. of the resections performed in our own clinic.

Chart No. 1 presents the death analysis.

Chart No. 2 presents the results in gastroenterostomy.

Chart No. 3 presents the results in partial gastrectomy.

Chart No. 4 presents the results in cases treated conservatively.

SURGICAL THERAPY FOR GASTRIC AND DUODENAL ULCER

POST-OPERATIVE MORTALITY IN GASTRIC AND DUODENAL ULCER

1. GASTRO-ENTEROSTOMY MORTALITY 15.1%

HEMORRHAGE FROM ULCER - 3 DAYS
 HEMORRHAGE FROM STOMA - 1 DAY
 ACUTE DILATATION OF STOMACH - 36 HRS. (STOMA INTENT)
 HEMORRHAGE - 3 DAYS
 PERITONITIS - LEAKAGE AT STOMA - 14 DAYS
 ACUTE ILEUS - UREMIA - 28 HOURS
 HEMORRHAGE FROM STOMA - 3 DAYS
 DEATH ON OPERATING TABLE - (PERFECT SHAPE - NARCOSIS ?)
 PNEUMONIA - 3 DAYS
 PNEUMONIA - 8 DAYS (WRETHED SHAPE - AGED 72)
 PNEUMONIA - 3 DAYS
 PNEUMONIA - 3 DAYS
 PNEUMONIA - 5 DAYS
 PNEUMONIA - 15 DAYS
 PNEUMONIA - 9 DAYS
 PULMONARY INFARCT, INFECTED - PLEURISY - 15 DAYS
 PULMONARY EMBOLISM - 9 DAYS
 PULMONARY EMBOLISM - ABSCESS OF LUNG, DRAIN - 61 DAYS

MORTALITY DUE TO TECHNICAL ERROR - 5.9%

2. PARTIAL GASTRECTOMY MORTALITY 19.6%

PERSISTENT VOMITING - UREMIA - 6 DAYS (POOR RISK)
 ACUTE ILEUS - PERITONIAL ABSCESS - HEMORRHAGE - 4 DAYS
 VOLVULUS - LEAKAGE OF DUODENUM WITH LOCALIZED PERITONITIS - 7 DAYS
 MARGINAL ULCER - PERITONITIS - GANGRENE OF LUNG - 3 WEEKS
 SHOCK - 48 HOURS (HIGH (LESSER CURVATURE ULCER)
 HEMORRHAGE - LEAKAGE - ILEUS - 9 DAYS
 LEAKAGE DUODENAL STUMP - PERITONITIS - 20 DAYS
 LEAKAGE DUODENAL STUMP - PERITONITIS - 1 DAY
 LEAKAGE DUODENAL STUMP - PERITONITIS - 8 DAYS
 ACUTE ILEUS - 13 DAYS
 LEAKAGE GASTRIC STUMP - PERITONITIS - 3 DAYS
 ACUTE PANCREATITIS - 3 DAYS
 PNEUMONIA - 4 DAYS
 PNEUMONIA - 4 DAYS
 PULMONARY EMBOLISM - 15 DAYS

MORTALITY DUE TO TECHNICAL ERROR - 15.8%

CHART I

A FOLLOW-UP STUDY OF THE RESULTS OF SURGICAL THERAPY IN GASTRIC AND DUODENAL ULCER

GASTRO-ENTEROSTOMY

119 CASES

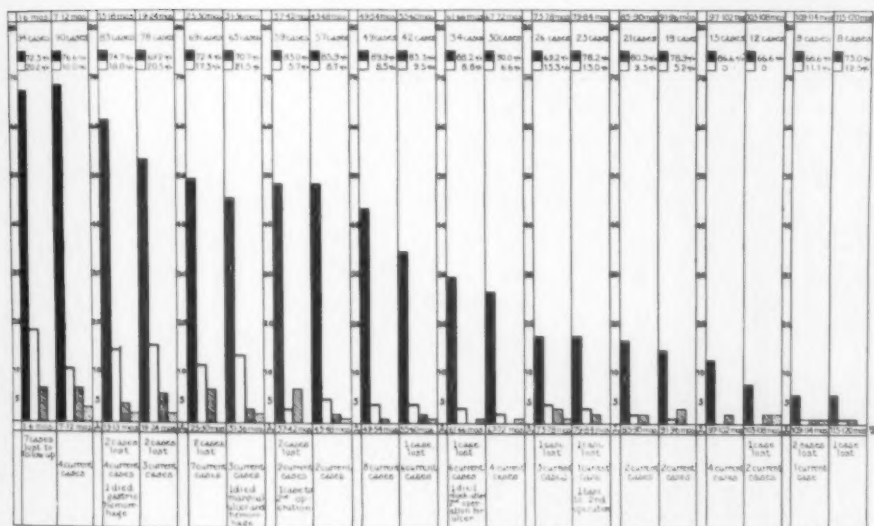


CHART II

FORDYCE B. ST. JOHN

A FOLLOW-UP STUDY OF THE RESULTS OF SURGICAL THERAPY IN GASTRIC AND DUODENAL ULCER

2. PARTIAL GASTRECTOMY

76 CASES

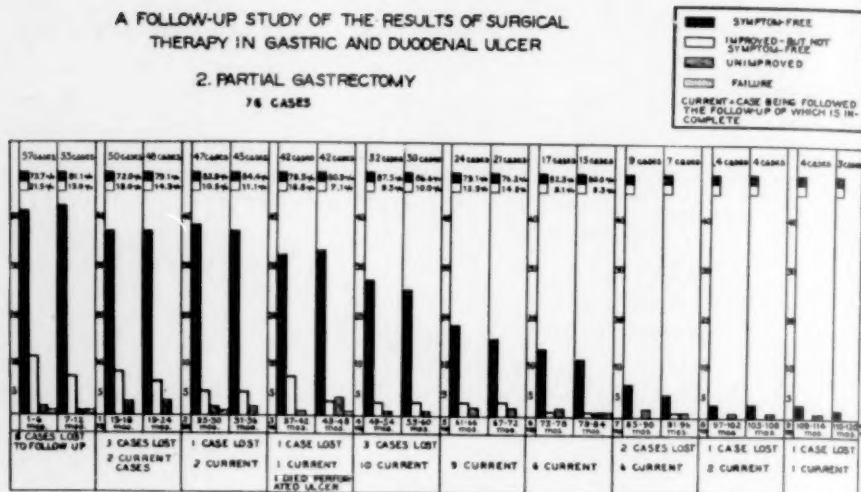


CHART III

A FOLLOW-UP STUDY OF THE RESULTS OF SURGICAL THERAPY IN GASTRIC AND DUODENAL ULCER

3. CONSERVATIVE TREATMENT

92 CASES

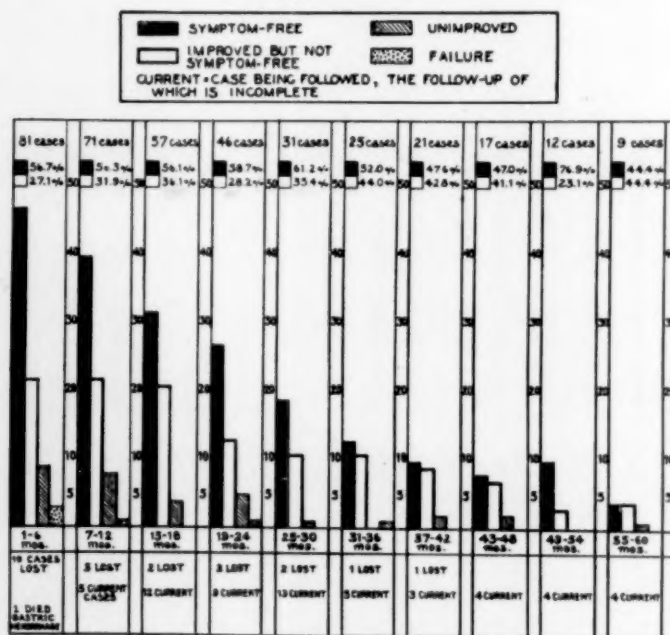


CHART IV

SURGICAL THERAPY FOR GASTRIC AND DUODENAL ULCER

Chart No. 5 presents the method of comparison of the various forms of treatment shown in continuity.

FOLLOW - UP RESULTS IN GASTRIC AND DUODENAL ULCER
WITH VARIOUS TYPES OF THERAPY

		MONTHS									
		1 - 6	7 - 12	13 - 18	19 - 24	25 - 30	31 - 36	37 - 42	43 - 48	49 - 54	55 - 60
1. GASTRO - ENTEROSTOMY	NO. OF CASES	94	90	83	78	69	65	59	57	49	42
	% SYMPTOM - FREE	72.3	76.6	74.7	69.2	72.4	70.7	83.0	85.9	89.9	83.3
	% IMPROVED	<u>20.3</u>	<u>10.0</u>	<u>18.0</u>	<u>20.5</u>	<u>17.3</u>	<u>21.5</u>	<u>5.7</u>	<u>8.7</u>	<u>8.5</u>	<u>9.5</u>
		92.6	86.6	92.7	89.7	89.7	92.2	88.7	94.6	98.4	92.8
2. PARTIAL GASTRECTOMY	NO. OF CASES	57	53	50	48	47	45	42	32	30	24
	% SYMPTOM - FREE	73.7	81.1	72.0	79.1	82.9	84.4	78.5	80.9	87.5	86.6
	% IMPROVED	<u>21.5</u>	<u>15.0</u>	<u>18.0</u>	<u>18.3</u>	<u>10.3</u>	<u>11.1</u>	<u>18.8</u>	<u>7.1</u>	<u>9.3</u>	<u>10.0</u>
		95.2	96.1	90.0	93.4	93.4	95.5	97.3	88.0	96.6	96.6
3. CONSERVATIVE TREATMENT	NO. OF CASES	81	71	57	46	31	23	21	17	12	9
	% SYMPTOM - FREE	56.7	56.3	56.1	58.7	61.2	52.0	47.8	47.0	76.9	44.4
	% IMPROVED	<u>27.1</u>	<u>31.9</u>	<u>36.8</u>	<u>28.2</u>	<u>35.4</u>	<u>44.0</u>	<u>42.8</u>	<u>41.1</u>	<u>23.1</u>	<u>44.4</u>
		83.8	88.2	92.9	86.9	96.6	96.0	90.6	88.1	100.0	88.8

CHART V

CONCLUSIONS

1. The high mortality in gastroenterostomy in this series is largely due to pulmonary complications. General anæsthesia has been used as a rule. Undoubtedly local or spinal anæsthesia would have lowered the incidence of pneumonia.

2. The high mortality in partial gastrectomy is probably due primarily to the fact that it has not been performed in simple duodenal or pyloric ulcer, but rather in the advanced, penetrating lesions of the pylorus and lesser curvature.

3. Medical treatment by the surgeon has been of educational value.

4. A follow-up study in continuity presents illuminating facts, the most important of which is the evidence of fluctuation of result due to intangible factors. These require further investigation.

5. Observations of the result of treatment should not be discontinued at any definite period following operation.

6. It must be borne in mind in comparing surgical and medical results that surgery in most clinics to-day in simple ulcer is only instituted at the point where medicine has failed.

The author wishes to acknowledge the assistance
of Mr. E. Caughlin of the third year class of
Columbia University Medical School.

PEPTIC ULCER SURGICAL ASPECTS INCLUDING END-RESULTS

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OF NEW YORK, N. Y.

THIS WORK WAS AIDED BY A GIFT OF MRS. JOHN L. GIVEN IN SUPPORT OF SURGICAL RESEARCH

THIS report represents a personal study of a group of 152 surgically treated peptic ulcers from the Department of Gastroenterology of the Cornell Clinic. The writers believe that this group is unique in that the cases were operated on in many different hospitals (twenty-six) by many different surgeons (forty-six). Many of the cases, after having been advised to have surgery performed, have gone to the referring physicians or to other clinics. Therefore this series seems to offer a very fair cross-section of results obtained from surgery performed in this condition around New York City.

In pursuing this work the first step was to study in some detail each of the case records on file at the clinic, checking the pre- and post-operative diagnoses, the type of operation performed, and listing the cases suitable for follow-up. It has been possible to personally examine eighty-five cases of operated peptic ulcer. Each case was examined and closely questioned concerning the result, and in all cases the patients were given an X-ray examination by the writer in the Clinic Department of Röntgenology. It is felt therefore that since the group was examined by one who had nothing to do with the surgery performed conclusions can be taken as unbiased.

Diagnosis.—The diagnosis of duodenal ulcer was made in ninety-two cases and the ulcer was found in the position indicated by X-ray in eighty-two, or 89 per cent., of the patients. In only four, or 4.3 per cent., was no lesion found and in the remaining cases a gastric ulcer was found in one, a pyloric ulcer was found in three, and a carcinoma of the pylorus in two. With respect to those cases in which no lesion was found it must be kept in mind that this does not entirely rule out ulcer, for there is one case in our follow-up series in which no ulcer was found at the first operation only to have it demonstrated at the second exploration.

The diagnosis of "ulcer or carcinoma" (lesion near the pylorus) was made in sixteen cases and all of these showed a lesion, three being duodenal ulcer, six cancer of the stomach, four gastric ulcer, one showed a cancer developing in a gastric ulcer, and the other two were extragastric lesions, a chronic pancreatitis and a chronic gall-bladder with peri-duodenal adhesions.

Twenty-nine cases were diagnosed as gastric ulcer and this type of lesion was found in seventeen, or 62 per cent., four proved to be carcinoma, one showed both gastric and duodenal ulceration, one was lymphosarcoma, one was a Harris' band, and one was a duodenal ulcer with pre-pyloric adhesions. One was duodenal adhesions and one was a gastric ulcer with a chronically diseased gall-bladder. Thus in this twenty-nine cases only two, or 6.9 per cent., failed to show either ulceration or neoplasm.

SURGERY OF PEPTIC ULCER

One case was diagnosed duodenal ulcer with diverticulum and these were found. Two cases were diagnosed merely pyloric obstruction and in these were found pyloric ulcers. One case was "cancer, ulcer, or spasm" and a negative stomach was found.

This series shows that it is most difficult to definitely localize the parapyloric lesions, that is, the lesions which are within a short distance one side or the other of the pyloric ring. And it must be said that probably the difficulty is not all on the side of the expert Röntgenologist. The lesion in seven cases was localized at the pylorus; in six of these the operator placed it in the duodenum and in one on the gastric side. In eight cases the lesion was called parapyloric and in four of these a duodenal ulcer was found, in two a gastric ulcer, and in one both a pre- and post-pyloric ulcer, and duodenal adhesions only in one case. Two cases were diagnosed "parapyloric ulcer or carcinoma" and in one of these a pre-pyloric ulcer was found and in the other was a duodenal ulcer. One was said to be "parapyloric ulcer with chronic gall-bladder disease" and a duodenal ulcer alone was found. Two were called "pyloric and pre-pyloric ulcer," there being found in one of them a gastric ulcer and in the other both duodenal and gastric ulcers were present.

The question of the exact location with reference to the pylorus might seem to be more or less a quibbling proposition, but it is, in fact, a very important one because it must very largely influence the surgeon in deciding the question of operation in the upper age groups.

Cancer of the duodenum is very rare and if the lesion can be placed with surety in the duodenum the question of malignancy will not strongly influence us to advise surgery.

Of 3563 cases of malignant tumors of the intestine Brill found only 89, or 2.5 per cent., in the small intestine. (Quoted from Ewing, J., *Neoplastic Diseases*.) Since these figures include carcinoma of papilla of Vater and of the third portion of the duodenum it will be seen that the malignancies of the usual ulcer site must be very rare.

Gastric ulcer or adhesions of the antrum were suspected in one case which proved to be a duodenal ulcer. Three cases were prophesied to be "ulcer, cancer, or lues" and these proved to be in order a pre-pyloric ulcer, a cancer of the stomach, and a gastric ulcer with tuberculous peritonitis. There was no proven case of gastric lues in this series. "Pyloric ulcer or cancer" was predicted in two cases which proved at operation to be a cancer of the stomach and a duodenal ulcer. Gastric ulcer was found in only one case which was diagnosed as cancer. "Duodenal ulcer and chronic cholecystitis" was proven in one case and a case of so-called duodenal ulcer with diverticulum of the jejunum proved to be an hour-glass stomach due to ulcer. A duodenal ulcer was found in only one case in which duodenal adhesions were diagnosed and in one case in which "adhesions or duodenal ulcer" were predicted, no lesion was found.

To summarize, in this group of 174 cases a definite lesion was found

in 167 cases, or 95.9 per cent. This demonstrates very forcibly the efficiency of modern X-ray diagnosis in competent hands.

The group of 152 peptic ulcers is composed of 117 duodenal ulcers (including pyloric and post-pyloric), three double lesions (gastric and duodenal), and thirty-two gastric ulcers.

Treatment.—The patients treated at the Cornell Clinic come from the middle classes and are of moderate means. Therefore, the time element in treatment is a very important economic factor due to the fact that it is essential that they be put in condition to earn their living at the earliest possible moment. They are not able to afford experimentation in treatment nor are they in most cases able to pamper their digestive tracts. In fact, many of them have great difficulty in using an ambulatory ulcer diet both for financial reasons and because of racial habits of eating.

Unless there is indication for immediate operation, such as obstruction, bleeding, perforation, or penetration, the patients are routinely put on a standard ulcer diet of high-calory bland type with three moderate-size and three small meals daily. In addition, they are given a teaspoonful of a neutralizing powder *t.i.d.* The average case shows an immediate although sometimes temporary response to this treatment. Some of the cases, of course, do not respond at all and are advised to have surgical intervention after what seems to be a fair trial. Many of them are carried along with good relief for many months, or even years, but as is the case with all such groups they have a tendency to drift away into other hands after a few months and it is difficult to gauge results accurately. Those who do not respond are submitted to operation.

In the 117 operated cases of duodenal ulcer the average age at entering the Clinic was 37.8 years the youngest being seventeen and the oldest sixty-two. The average duration of pre-operative medical treatment in this group was 5.1 months. However, because of above-mentioned indications, thirty-nine of the 117 cases were operated upon immediately, making the average duration of treatment of the remaining seventy-five cases 7.8 months.

Of the thirty-five cases of operated gastric ulcer twenty-six were operated upon immediately, thus showing the influence of the fear of malignancy. The remaining nine cases received an average of 8.1 months of observation at the clinic and the average age of all the operated gastric ulcers on entering the clinic was forty-four years.

The average case of gastric ulcer in this series has had symptoms for 5.9 years pre-operative and the duodenal ulcers have had symptoms for an average for the entire group of 6.9 years between the onset of symptoms and the operation. The longest period between onset of symptoms and operation in the duodenal group was twenty-eight years and in the gastric group thirty-four years; and the shortest period in each group was respectively three months and two months. Twelve cases of the entire group had symptoms for over twenty years and thirty-two of them suffered for over ten years without relief.

SURGERY OF PEPTIC ULCER

It is interesting to note that in this series of 152 cases, twenty-four, or 15.8 per cent., had had previous operations for digestive symptoms. These include two cases of cholecystectomy for the same symptoms, one of which had a subsequent negative exploration and one case which had a cholecystectomy and exploratory gastrotomy without relief. There were, in addition, three cases which had single acute perforations, two cases which had had previous gastroenterostomies and one case in which the ulcer of the stomach had been excised, the case several years later requiring a gastroenterostomy for relief of stenosis. All of these were apparently carefully explored and given the indicated treatment according to the evident pathology but the same cannot be said for those cases which previously had appendectomy for the same digestive disturbances. This group comprises fourteen and includes only chronic cases and only those cases whose ulcer symptoms started before the onset of the so-called appendix symptoms. These fourteen are all duodenal ulcers. It is interesting that none of the gastric ulcers had been previously operated on for chronic appendicitis. Thus 11.9 per cent. of the operated duodenal ulcers had had previous laparotomies for chronic appendicitis and many of them showed McBurney scars.

INDICATIONS FOR OPERATION: 1. *Persistent or recurrent pain* has been the indication for operation in fifty-two duodenal ulcers and three gastric ulcers and, in addition, in one double lesion. The pain was unrelieved by medical treatment or recurred in severe form after the usual ambulatory treatment. The test of medical treatment is indeed severe, for the patients are forced to earn their own living and many choose the operation or are offered operation when medical treatment has failed. Success of any form of treatment in this type of patient usually means the ability to put in from eight to twelve hours at hard work.

2. *Pyloric obstruction.*—This is, of course, a prime indication for surgery and no hesitation is felt in advising an operation when the patient shows twenty-four-hour retention of part of the opaque meal after this finding is confirmed by a second examination. Thirty-two cases of duodenal ulcer and ten cases of gastric ulcer were operated on because of this indication.

3. *Penetration.*—A deeply penetrating lesion of the lesser curvature is considered an indication for surgery if it does not improve in two weeks clinically and by X-ray. The same advice is given to a patient whose pain suddenly changes in character and severity and which is not relieved by alkalis or food. These cases are considered candidates for acute perforation and are usually advised to undergo operation unless they can be kept under very close supervision. Ten gastric and three duodenal ulcers have been operated on for this indication. One double lesion also was operated on for this indication.

4. *Acute perforation.*—Five duodenal ulcers have been operated for this reason and likewise two on the gastric side. In addition, one double lesion has been operated on for this reason. Several more of each group have perforated after having been sent to the surgical wards and while awaiting opera-

tion for other indications. Few acute perforations are seen at the clinic because most of them are taken to the hospitals by the ambulances from the street or from work.

5. *Hæmorrhage*.—Only three cases, all duodenal, have been explored because of hæmorrhage and, in fact, only seventeen patients in the entire ulcer series gave a history of tarry stools. One case with a double lesion was operated on because of both bleeding and perforation.

6. *Question of malignancy*.—At this clinic every effort is, of course, made to decide whether or not a lesion is malignant and when the diagnosis between ulcer and cancer is doubtful operation is always advised particularly in patients over forty. Seven parapyloric lesions in which cancer was suspected have been operated on and found to be duodenal ulcers and seven gastric ulcers have been found in the same type of parapyloric lesion.

7. *Marginal ulceration*.—This was diagnosed in two cases and is considered a real indication because of the severe symptoms and the danger of complications, such as perforation and fistula formation.

8. *Unknown indications*.—At other clinics operations were undertaken for reasons unknown to us in thirteen duodenal ulcers after the patients had left the clinic for treatment elsewhere.

TYPE OF OPERATION. 1. *Gastroenterostomy* (posterior) was employed in over half the cases, being used in eighty-three duodenal ulcers and three gastric ulcers. Additional cases have been subjected to this operation in combination with other procedures. One chronic and one perforated duodenal ulcer had a suture of the ulcer combined with gastroenterostomy. Cauterization of the ulcer and gastroenterostomy were combined in three chronic duodenal ulcers and two gastric ulcers. One duodenal ulcer had a pyloric ligation combined with gastroenterostomy and one gastric case with hour-glass contraction was given a double gastroenterostomy. Thus ninety-eight cases had gastroenterostomies, either simple or combined with other procedures.

2. *Polya resection* with end to side anastomosis of stomach to jejunum was done in eleven duodenal ulcers and twelve gastric ulcers and also in one double lesion.

3. *Billroth II* resection with posterior gastroenterostomy was done in five chronic duodenal ulcers and nine chronic gastric ulcers and in one each of perforated gastric and double lesion.

4. *Pyloroplasty* (alone) was performed in only two cases, both being, of course, duodenal ulcers.

5. *Billroth I, sleeve resection and cautery excision* combined with *gastro-duodenostomy* were each used once in gastric ulcer.

6. *Cautery excision (alone), freeing of adhesions and unhooking of gastroenterostomy* were each done once in duodenal ulcer.

7. *Pyloroplasty plus wedge resection* was used once in a double lesion.

8. *Simple suture* of acute perforation was used in one case of gastric ulcer and three cases of duodenal ulcer.

SURGERY OF PEPTIC ULCER

MORTALITY (immediate operative).—Gastroenterostomy in ninety-two duodenal ulcers gave an operative mortality of 2.1 per cent. There was no mortality in six cases of gastric ulcer in which this operation was used.

Polya Resection in eleven duodenal ulcers showed an operative mortality of 36 per cent. and in twelve gastric ulcers a mortality of 17 per cent.

Billroth II in five duodenal ulcers showed no operative mortality while in ten gastric ulcers it showed 20 per cent. mortality.

Because of the smallness of the groups of the other types of operation their mortality will not be considered.

From the standpoint of safety it seems evident that in the chronic duodenal ulcer gastroenterostomy is the safest procedure and the preferability of this operation will be still further emphasized when end-results are considered. The lesson is not so clear in the case of gastric ulcer because of the small number of cases, but it seems that a resection large enough to include the whole lesion with either a Polya anastomosis or posterior gastroenterostomy offer the best chance of survival.

TABLE I
POST-OPERATIVE COMPLICATIONS

	Gastric	Duodenal	Double Lesion
Hernia.....	4	9	
Pneumonia.....	4	4	
Evisceration.....	1	4	1
Cellulitis of wound.....	3		
Fatal post-operative vomiting.....	1	1	
Duodenal fistula.....		1	
Phlebitis.....	1		
Acute psychosis.....	1		
Erysipelas.....	1		
Septicæmia and subdiaphragmatic abscess.....	1		
Peritonitis.....			1
Fatal shock.....	1		
Pulmonary œdema.....		1	
Lung abscess.....		1	

The primary operative mortality of the whole group has been sixteen cases, or 10.6 per cent. The duodenal ulcers had a general mortality of 5.9 per cent. and the gastric ulcers a general mortality of 22 per cent. Two of the three double lesions died following operation. A startling feature of this mortality is the large number of cases of evisceration and the high mortality of the condition.

The mortality seems large but it must be remembered that there has been no selection of cases. They have been disposed of as they came to view and many of the cases which died had serious pre-operative complications.

One perforated gastric ulcer, two perforated duodenal ulcers, and one case which had a chronic gastric ulcer and two perforated duodenal ulcers died after operation. Only one of these, a duodenal, was given a resection,

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TABLE II
CAUSES OF DEATH

	Duodenal	Gastric	Double Lesion	Secondary Operation
Evisceration.....	3			1
Evisceration and hæmorrhage ..			1	
Pulmonary oedema.....	1			
Pneumonia.....	1	4		
Peritonitis and pneumonia.....			1	
Lung abscess.....	1			
Psychosis.....	1			
Post-operative vomiting.....		1		
Shock.....		1		
Septicæmia.....		1		
Intestinal obstruction.....				1

the others being merely sutured. The serious nature of the cases is shown by the following example:

Charles B., aged forty-two, was admitted to the clinic complaining of typical ulcer pain and extreme loss of weight over a period of ten years. Fluoroscopy showed an extensive duodenal lesion and on medical treatment he did well for two years when he suddenly gave evidence of perforation and serious bleeding. He was advised to enter the hospital immediately but did not do so for four days. At operation there were found two perforated duodenal ulcers. The perforations were closed and gastroenterostomy was done. Several days later the wound broke open and secondary suture was performed but the patient died on the thirteenth post-operative day. Autopsy showed in addition to the other lesions a large gastric ulcer. The cause of death was given as acute dilatation of the stomach, hæmorrhage and evisceration.

Disregarding the acute perforations, of which only eight were seen at the clinic, the duodenal mortality becomes 4.4 per cent. and the gastric becomes 26 per cent.

Three cases of duodenal ulcer are known to have died from one to four years after operation from causes not related to their ulcers. In addition, one duodenal ulcer died from intestinal obstruction eleven months after the first operation:

Charles K., aged forty-eight, was admitted to the clinic in 1922 complaining of ulcer pain, fluoroscopy showing an extensive post-pyloric ulcer with retention. Surgery was advised immediately but gastroenterostomy was not done until two months after admission. Ten months later the patient returned complaining of moderate recurrence of pain and X-ray showed a hyperactive stomach with the meal emptying through both the cap and stoma. One month after this word came that he had developed intestinal obstruction, had been operated on without cause for the obstruction being found and had died sixteen days post-operative.

A total of twenty-two cases of the group (152) are dead, or 14.2 per cent.

Secondary operations.—Two gastric ulcers had secondary operations, both with fatal issue: one for persistent vomiting unrelieved by a jejunostomy, and a second (perforated) for evacuation of a subdiaphragmatic abscess. Four duodenal ulcers had secondary suture of the wound for evisceration as did one double lesion and one gastric ulcer. One duodenal ulcer developed a gastrocolic fistula three years after gastroenterostomy.

SURGERY OF PEPTIC ULCER

Henry D., aged forty, was admitted to the clinic in 1924 complaining of a typical ulcer syndrome. After fluoroscopy, which showed a post-pyloric ulcer, medical treatment was tried for six weeks without relief and gastroenterostomy was performed. The convalescence was stormy. After sixteen months of freedom from symptoms he again began to have pain and X-ray showed a tender stoma.

It is probable that about this time he developed a marginal ulcer although he was fairly well until eighteen months later when he began to have gaseous eructations followed in a short time by a severe diarrhoea and loss of weight. Barium enema showed a gastrocolic fistula and the patient was shortly explored. The fistula was closed and the gastroenterostomy was reestablished. The patient made a good recovery and was well one year later, barium enema at that time showing no evidence of fistula.

The following case which also had a secondary operation is interesting from several angles:

Anna D., aged thirty-two, was admitted to the clinic in 1927 complaining of a mild ulcer syndrome and also of two fainting attacks followed by tarry stools. Fluoroscopy showed a small lesion near the apex of the duodenal cap.

Because of the history of recurrent severe bleeding, operation was advised. An ulcer (of the second portion of the duodenum) was resected and a gastroenterostomy was performed. She made good recovery but eight months after leaving the hospital she had another severe hæmorrhage and a second operation was performed consisting of a resection of the pylorus converting the gastroenterostomy into a Billroth II resection. One year after the last operation the patient was in satisfactory condition.

It seems likely that in this case there was a second ulcer which was not found at the first operation and which was causing the bleeding or that a second bleeding ulcer formed subsequent to the first operation. This case well illustrates the fact that when a gastroenterostomy stoma has been placed at the mid-portion of the stomach it is possible if necessary to convert this procedure into a Billroth II resection very easily.

Two cases were operated upon three times after admission to the clinic. One of these is as follows:

Thomas McG., aged thirty-four, was admitted to the clinic complaining of periodical attacks of pain over a period of eight years. At fluoroscopy a diagnosis of duodenal ulcer and chronic appendicitis was made and after diet for two months had not relieved him, operation was advised. A healed duodenal ulcer with adhesions and a chronic appendix were found. The adhesions were freed and appendectomy done.

Soon after operation the old symptoms recurred and a second operation, cholecystectomy, excision of the ulcer and gastroenterostomy were done.

As a result of this procedure the patient developed a ventral hernia which made necessary a third operation.

The following case also had three operations and illustrates the severe nature of the disease and the severe complications found even in this small group of cases. It also illustrates the occasional durability of the human frame.

John M., aged twenty-four, was admitted to the clinic in 1924 complaining of ulcer pain which he had had for five years. Four years before he had been operated on for perforated duodenal ulcer. Two years after this he had had a second suture of a perforation, as before, with no gastroenterostomy. At the second operation, however, the ulcer was sutured, an abscess of the pancreas drained, and an appendectomy per-

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formed beside freeing adhesions and repair of a ventral hernia resulting from the first operation.

In spite of this formidable procedure his pain recurred and at the clinic fluoroscopy showed a duodenal ulcer with adhesion, operation being advised.

At operation there was found a third perforation extending this time into the liver. The ulcer and gastric antrum were removed and posterior gastroenterostomy performed (Billroth II).

At the present time, four and one-half years after the last operation, the patient is working twelve hours a day and complains of only slight nausea in the morning. He eats anything but pork, and fluoroscopy shows two-thirds of the stomach remaining and a finely functioning stoma. The patient is satisfied, and should be, after surviving all these troubles.

At the present time many surgeons do not believe in performing gastroenterostomy in perforated ulcers, particularly if the perforation is of more than a few hours' duration, but it seems clear that this case should have had one at the second operation instead of some of the other less indicated manipulations.

END-RESULTS

Eighty-five post-operative cases of peptic ulcer have been personally investigated in this study. All of these have been completely examined at the clinic. Their present condition has been directly compared with their status before operation. The average time of follow-up has been 3.2 years. The time of follow-up may be summarized as follows:

<i>No. of Cases</i>	<i>Time Followed</i>
15	1 year or less
16	1 - 2 years
6	2 - 3 years
15	3 - 4 years
7	4 - 5 years
15	5 - 6 years
11	6 - 7 years

An outstanding feature of the eighty-five operative cases has been the failure of the hospitals to follow their cases for more than a few months, and, in many cases, the follow-up, when attempted, has been very sketchy. In most instances it has not included an X-ray examination and many have been followed, if at all, only by letter. To our minds this is not sufficient. Some of these patients who are in good condition from a clinical standpoint show at X-ray examination serious difficulty which affects the prognosis and immediate course of action. Sometimes there seems to be little direct relation between the clinical findings and the functioning of the stomach under the fluoroscope.

Further, the vague character of the post-operative instructions as to treatment given many of them during even the first six months of their convalescence has been very noticeable. Some have been told they can eat anything; some have been given diet slips with careful instructions. Too many have been let go without being properly impressed as to the importance

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of care in diet. The whole situation resolves itself into the fact that someone should assume the responsibility for the patient as much after the operation as before and perhaps more so. This would improve results and would make happier many an uncomfortable post-operative case. It must be said that these cases usually cannot eat everything, as is sometimes so sanguinely promised, but they can usually become practically normal otherwise as opposed to their pre-operative condition of severe pain, vomiting, and loss of weight. The exceptions to this are found in the resected group. The moral to be drawn is that someone should be responsible for these people and they should not be made to suffer from the break in continuity of treatment which usually results when they are passed from clinician to surgeon and back again. All theory to the contrary notwithstanding, an ulcer of the duodenum even after removal remains a potential source of trouble and when the question is asked how long a post-operative patient must remain under observation, the answer should be "permanently."

The evaluation of the results of any procedure is quite difficult. The personal attitude of the examiner, mental attitude of the patient, and the method of the examination all enter into the equation. We have classified as excellent the cases which are free from symptoms, are able to use a liberal diet, and have a well-functioning stomach by X-ray. Those which have slight attacks of pain occasionally and needed a moderately restricted diet or perhaps have a stomach which by X-ray does not seem to function at its highest efficiency are classified as "satisfactory." Those which have their old trouble although in milder form and need a strict diet are classified "fair." In these latter the operation cannot be said to have entirely failed. Those cases which are unimproved or developed serious complications are classed as "unsatisfactory."

Posterior gastroenterostomy in duodenal and pyloric ulcer gave excellent results. Performed in fifty-four followed cases for an average of 3.5 years the results were excellent in thirty-nine, or 72 per cent. Eleven of these cases can be classed as satisfactory (20 per cent.); three had fair results, and two were unsatisfactory. To illustrate an excellent result:

Mary C., aged thirty-three, was admitted to the Cornell Clinic in December, 1925, complaining of epigastric pain relieved by food and vomiting. X-rays showed an extensive duodenal ulcer, duodenal stasis and moderate ptosis. The routine medical treatment gave no relief and operation was advised. Posterior gastroenterostomy was performed. At the last examination, three years post-operative, she was free from pain, had gained twelve pounds, could eat anything, and X-ray showed a well-functioning stomach.

The following illustrated a case which is classified satisfactory:

Armando C., aged forty-three, was admitted to the clinic in March, 1923, complaining of epigastric pain of seven years' duration, the pain being relieved by soda and vomiting. X-ray showed a post pyloric ulcer. He was treated by his own physician and three months later a posterior gastroenterostomy was performed. He was well for five and one-half years, until six months before his last visit to the clinic when he had begun to have slight pain. However, he was twenty-five pounds heavier than at the

time of operation and was well satisfied with the results. X-ray showed an overactive stomach with deep peristaltic waves, the stoma emptying very slowly and the pylorus being only slightly patent. The stoma was placed higher posteriorly than usually and well up on the greater curvature of the stomach.

This case illustrates several points of interest. In the first place this patient was well for five and one-half years before he had a recurrence of symptoms, showing how difficult it is to reach any final decision with regard to any particular case at any particular time. Secondly, it illustrates the importance of checking these cases by X-ray for the placing of the stoma and the overactivity of the stomach could only be determined in that way. Thirdly, it shows one error, according to common usage, in placing the stoma.

The following illustrates a "fair" result:

Hubert M. was admitted to the clinic in 1927. The diagnosis of duodenal ulcer was made and three months' medical treatment failed to relieve him. Operation was finally advised, mainly for a suspected subacute appendix. Since operation (gastroenterostomy and appendectomy) he has had burning pain in the epigastrium relieved by soda. He has vomited and belches a great deal and is sick enough at times to quit work. X-ray shows the meal to be emptying through both the cap and the pylorus. The stomach was hyperactive.

In spite of all these symptoms the patient declared himself to be somewhat improved.

There were two completely unsatisfactory cases in this group of gastroenterostomies. The first developed a gastrocolic fistula, probably on the basis of a marginal ulcer and has been quoted above. The second case follows:

Ruth S., aged twenty-five, was admitted to the clinic in October, 1925, complaining of ulcer pain. Fluoroscopy showed a very defective duodenal cap but no obstruction. She was very obese because of a bilateral salpingo-oophorectomy. After eight months without permanent relief, operation was advised and gastroenterostomy was performed. She was well for two and one-half years but then began to have pain. Examination showed a huge ventral hernia and a markedly contracted stoma which was shown only on the plates. Operation (diagnosis marginal ulcer) was advised but refused. There was a very small stoma with evidence of many adhesions in the same region on the greater curvature of the stomach.

The placing of the stoma as shown by the post-operative X-ray has been usually in the dependent portion of the stomach. Many, however, have been placed near the pylorus and in a few of this type the emptying of the stomach through the stoma has so nearly simulated the action of the normal pylorus that it was hard to distinguish between the two. The actual location of the stoma, within reasonable limits, seems to have little effect on the clinical result and even on the emptying as determined by the opaque meal. The following case is an extreme example of the fact:

Michael K., aged thirty-one, was admitted to the clinic in 1924 and the diagnosis of parapyloric ulcer was made. He has lost twenty pounds and showed twenty-four hour retention, gastroenterostomy being performed. Examination five years after operation proved that he had gained fifteen pounds, was doing heavy work as a carpenter, and was having only a mild attack of pain each summer. He was eating everything. X-ray examination showed the most extreme example of poor placing of the stoma. It was

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on the greater curvature of the stomach but very near the cardia. The stomach emptied rapidly through the stoma and the patient was entirely satisfied with the result.

Examination of these patients has left the writer with the impression that the antral location is best, provided there is no likelihood of the future necessity of resecting, in which case an antral location would make resection more difficult.

To summarize: of fifty-three gastroenterostomies, thirty-seven had the stoma at the dependent portion of the pars media, eleven had the stoma on the antrum, two had the stoma high posteriorly, and in one, the case mentioned above, the stoma was placed far to the left and near the cardia. In addition, two cases showed a stoma slightly to the left of the mid-portion.

One of the most interesting cases this study has brought to light is a case of duodenal ulcer with simple gastroenterostomy. This case came back four and one-half years after operation and had gained thirty-five pounds. He was the picture of health and used an unlimited diet. Two weeks before his return he had begun to suffer slightly with epigastric pain coming on one hour after meals whereas his old pain had been three hours after meals. He appeared to be in fairly satisfactory condition until X-ray examination proved the existence of a large penetrating ulcer on the lesser curvature of the stomach. It seems that the gastric lesion is a recent development.

Polya resection (or a variation of this operation) was performed in seven returned cases of duodenal ulcer. Three of these cases can be classed as excellent, one as satisfactory, two as fair and one as unsatisfactory. X-ray showed all of these cases to have a well-functioning stomach. Two which were "satisfactory" had associated gastro-intestinal trouble which interfered with a perfect result, and one of the "fair" cases still had pain and the need for alkaline powders. The other "fair" result was said to have developed a marginal ulcer which could not be demonstrated at the recent examination and in addition was definitely neurotic.

One patient had his gastroenterostomy unhooked six months after the first operation when a marginal ulcer was suspected but not found. This patient is at present "satisfactory," having very slight distress and a somewhat limited diet. It is questionable whether his ultimate result will be good, many surgeons believing that unhooking gastroenterostomy in duodenal ulcer always leads to a reactivation of the ulcer.

One duodenal ulcer which had a simple resection of the ulcer returned 5.75 years after operation with the history of belching, pain and nausea, although these symptoms were not severe. She was classed as "fair." It is probable that this patient would have had a much more nearly perfect result if gastroenterostomy had been added to the procedure. None of the recently operated ulcers have had resection without gastroenterostomy.

Another case had a pyloroplasty (Horsley) for duodenal ulcer. He gained weight and was symptom-free 6.5 years post-operative but it classified only "satisfactory" because of a hyperactive, hyperperistaltic stomach.

One penetrating duodenal ulcer had the ulcer infolded and gastroenterostomy performed. The treatment was probably satisfactory but the result was obscured by a psychosis, one of the few encountered in this group which was remarkably free from such types of patients.

Another case had cauterization of the ulcer with gastroenterostomy and had no trouble 6.5 years after operation.

The two perforated duodenal ulcers were each examined 3.5 years after operation. Each had had simple suture and X-ray of one showed a normal duodenum and stomach while the other showed a persistent defect. Each was having an occasional mild attack of pain but no obstruction had developed as is so often to be expected in these cases of suture following perforation. They are classed as "satisfactory."

Two duodenal ulcers, already cited, had Billroth II resections, one as the second operation for bleeding and the second as the third operation. The latter is classed as excellent and the first as "satisfactory" because of mild symptoms.

From these cases it seems possible to draw the not very novel conclusion that posterior gastrojejunostomy is the operation of choice in the hands of the average surgeon in duodenal ulcer provided the indications are good. It will cover the whole field except perforation, even including bleeding. The mortality is low and we have shown the results to be as satisfactory as the results of almost any type of therapeutic procedure.

Seventeen gastric ulcers have been examined. Of the various operations performed on these cases the Polya or its variations have been done most frequently (12 times). The remarkable features of the eight cases (of Polya resection) examined is that they were uniformly excellent results—provided the patients recovered from the operative procedure. Only two died, one of tuberculous peritonitis and the other of pneumonia. The cases were followed an average of 2.8 years post-operative.

One case of wedge resection for ulcer of the lesser curvature has been examined. Eighteen months after operation the patient was symptom-free and X-ray showed no defect and no interference with peristalsis. Disregarding a huge incisional hernia the result would be "excellent."

Suture of a perforated gastric ulcer near the pylorus with gastroenterostomy was done once and this case must be classed "unsatisfactory" because of the probable development of a marginal ulcer. This was unproved because of refusal of the patient to submit to a second operation, although he was very miserable.

Only one case with a gastric ulcer high on the lesser curvature which had had a gastroenterostomy alone returned for examination. In this case the placing of the gastroenterostomy below the site of the ulcer high on the lesser curvature was futile and may also illustrate the possibility of malignant degeneration of a gastric ulcer although time alone can settle the latter point.

Edward C., aged forty, was admitted to the clinic in 1927, complaining of indigestion which he had had for nine years. X-ray showed a penetrating lesion of the lesser

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curvature of the stomach near the cardia. Surgery was advised. The lesion seemed non-resectable and posterior gastroenterostomy was performed at the dependent portion of the stomach. Two years after operation the patient had gained no weight, had to be very careful of his diet, and X-ray showed finger-printing on the greater curvature which, in the opinion of the X-ray department, meant a malignant process.

Three cases of gastric ulcer in which Billroth II was done were examined and all were excellent. One gastroenterostomy was excellent and another was fair. In one of the hour-glass stomachs in this series a double gastroenterostomy was done and this was free of symptoms 7.5 post-operative. A double lesion for which had been performed a pyloroplasty and wedge resection was found to be free of symptoms six years after operation with an excellent functional result by X-ray.

CONCLUSIONS

1. The efficiency and reliability of X-ray diagnosis of peptic ulcer has been confirmed by this series of cases in which the pre-operative and operative findings have been compared.
2. Economic stress hastens operation in many of the cases appearing at the Cornell Clinic and probably more cases in this social stratum are operated upon than in other groups.
3. Gastroenterostomy has been shown to be a very safe procedure with a mortality of 2.1 per cent. in the hands of many different surgeons. It is likewise excellent from a therapeutic standpoint with 92 per cent. of satisfactory results.
4. The location of the gastrojejunostomy opening does not seem to greatly influence the clinical and mechanical results of operation.
5. Polya resection seems to be the best procedure in gastric ulcer and has given uniformly good results in this small series, but mortality is high.
6. These cases demonstrate the almost uniformly good results of operation for peptic ulcer in the hands of a comparatively large group of surgeons.
7. The accurate determination of end-results requires careful study over long periods. Many cases are followed too short a time and in too little detail.
8. Analysis of individual cases often affords information that is not obtained by a statistical study.

The preparation of this paper was aided by the invaluable advice and coöperation of the Departments of Gastroenterology and Röntgenology of the Cornell Clinic and the indebtedness is hereby acknowledged. Thanks are also due to the Clinic Executive Staff and Social Service Department for their aid in organizing this follow-up clinic. We should also like to express our thanks to the many surgeons and hospitals who have coöperated with us in furnishing information.

THE IMMEDIATE MORTALITY IN OPERATIONS FOR GASTRIC AND DUODENAL ULCER AND ITS CAUSES

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A STATISTICAL paper is of little interest but, if honest, of great value. The more it deals with failures the greater its value.

From January 1, 1920, to January 1, 1930, in my services at the Pennsylvania and Jefferson Hospitals, there have been operated upon 313 cases of duodenal and gastric ulcer. To this number are added twenty-one cases operated upon at the Bryn Mawr Hospital by three of the same group, making a total of 334. These operations do not represent all those done in these institutions, but only those in our own service. They have all been done by six men, Doctors Despard (deceased), Billings, Klopp, Flick, Walking and myself.

In this series of 334 cases, sixty-seven were cases of acute perforation which will be considered apart from the other larger group. There were eighteen deaths in these sixty-seven cases, a mortality of 26.8 per cent. Peritonitis was the cause of death in nine cases, chest pathology" in four cases, hæmorrhage in one, embolism in one, empyema in one, local peritonitis and acute degeneration of liver in one and the cause of death is not noted in one case. Ten of these patients were operated on within eighteen hours of the perforation, which is much too high a mortality following operation done within this period. In one of the fatal cases seventy-two hours had elapsed before operation, and in another forty-eight hours. Four deaths occurred in patients operated upon between eighteen and twenty-four hours after perforation. In two cases the duration was not noted. Among the cases which recovered, the interval between perforation and operation was "over twenty-four hours" in one, between nineteen and twenty-four hours in one, between thirteen and eighteen hours in five.

Some years ago Francis T. Stewart and I reported a series of cases in which every patient operated upon within eighteen hours of the perforation recovered, and all operated on, with one exception, after that time died. We are convinced that every hour that passes after the fifth or sixth without operation adds to the mortality. Time is a far more important element in these cases than the type of operation or the character of the after treatment. In these sixty-seven cases simple closure was done in forty-three and closure with gastrojejunostomy in twenty-four. The question of gastrojejunostomy is decided on the extent and duration of the peritoneal contamination and on the condition of the patient.

In these sixty-seven perforations only seven were of gastric ulcers. There were only three deaths in the twenty-four cases where a gastrojejunostomy

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was done, a 12 per cent. mortality, whereas there were fifteen deaths in forty-three cases where only closure was done, a mortality of 35 per cent. These figures are hardly comparable when, as has been said, the anastomosis is only done in the patients who are in the best condition.

Aside from the causes of the mortality already given, there were a variety of complications in the patients who recovered. There were two cases of parotitis; three of phlebitis of left leg; two of pulmonary collapse; one of bronchiectasis or lung abscess (sixteenth day after operation); one of late vomiting; one of purpura; one of bronchopneumonia (tenth day) and one of duodenal fistula, this case being complicated at time of perforation by an acute gangrenous appendicitis.

There were twenty-nine deaths in the 267 non-perforative cases, a mortality rate of 10.8 per cent. This mortality we will not attempt to ascribe largely to complicating conditions, multiplicity of lesions or multiple necessary operations, but will look for an explanation in the post-operative developments and in the autopsy records. It is true that in many cases there were present chronic perforations, especially into the pancreas, that a number had both duodenal and gastric ulcers, that a still larger number had gall-bladder conditions which required operation, and that in a large number the appendix was removed, but the mortality does not appear higher in these than in the uncomplicated cases.

The causes of death in this group were: peritonitis, three; pneumonia, eleven; collapse of lung, two; local peritonitis with lung abscess, one; pulmonary embolism, one; subphrenic abscess and empyema, one; subphrenic abscess and lung abscess, one (death on forty-eighth day); hæmorrhage, one (gastrectomy); intestinal obstruction, three (one on thirteenth day and one on seventeenth day both reoperated upon); shock, one (marked dehydration); sudden cardiac attack, one (ten days after operation, autopsy revealed no cause); post-operative delirium, one (patient tore his wound open on fifth day and tore a large hole in the mesentery requiring a resection of two feet of small intestine). The cause of death was not stated in two cases.

The only comfort to be derived from this list is its variety. The high percentage of lung complications, well over 50 per cent., although regrettable, is somewhat of a comfort as they can hardly be attributed to technical error. It will be seen later in considering the post-operative complications in the cases which recovered, that lung conditions, especially atelectasis, again outnumber all the others combined. Now that collapse is being more generally recognized and successfully treated and is no longer thought to be pneumonia, it may be hoped that it will become a less potent factor in the cause of death.

In going over the histories of the eleven cases where pneumonia was given as the cause of death, we were impressed with the idea that many of them were in reality cases of massive collapse.

In the 267 cases, 224 were duodenal ulcers, forty-one gastric and only two jejunal. Where there was both a duodenal and gastric ulcer, the cases were classed as gastric.

JOHN H. GIBBON

The great rarity of jejunal ulcer in our clinics, where gastrojejunostomy is the common operation for duodenal ulcer, is very striking, for surely all our jejunal ulcers have not gone elsewhere for diagnosis and treatment. We have never been able to understand the high percentage of jejunal ulcers reported from other clinics. The following tables give the operations performed and their mortality.

DUODENAL ULCER

Operation:	Number	Deaths
Gastrojejunostomy.....	142	15
Gastrojejunostomy Appendectomy.....	61	4
Gastrojejunostomy Appendectomy cholecystectomy.....	3	0
Gastrojejunostomy Appendectomy cholecystostomy.....	2	0
Gastrojejunostomy cholecystectomy.....	7	1
Pyloroplasty (Finney).....	1	0
Pyloroplasty Appendectomy cholecystostomy.....	1	0
Pyloroplasty Appendectomy.....	1	0
Excision—gastrojejunostomy—appendectomy.....	1	0
Cauterization—gastrojejunostomy.....	2	0
Pylorectomy.....	2	1
Cholecysto-gastrostomy (gall-stones).....	1	0
	224	21

GASTRIC ULCER

Operation:	Number	Deaths
Gastrectomy.....	15	2
Cauterization—gastrojejunostomy.....	8	2
Excision.....	4	0
Excision gastrojejunostomy.....	1	1
Pylorectomy.....	1	1
Cauterization—appendectomy.....	1	0
Cautery excision.....	2	0
Gastrojejunostomy.....	3	1
Gastrojejunostomy Cholecystectomy.....	2	1
Gastroplasty (hour-glass).....	1	0
Double gastrojejunostomy (hour-glass).....	2	0
Appendectomy.....	1	0
	41	8

JEJUNAL ULCER

Operation:	Number	Deaths
Gastrectomy.....	1	0
Restoration with resection of jejunum.....	1	0
	2	0

The complications in the cases which survived are much the same as in the fatal cases and in the cases of acute perforation. Lung conditions take first place. There are four instances of what was called "chest pathology"—diagnosis based on physical signs. These may have been instances of partial collapse as they all cleared up promptly. There were three cases of definite collapse and one of pleurisy. Suppurating parotitis occurred in four cases;

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in two it was double. Nonsuppurating parotitis developed in two instances. This condition has been rather conspicuous in our cases and has given us considerable concern. We try to make all patients chew gum after gastric operations and we think there has been but one case of parotitis where this was done. It has not occurred in the dehydrated cases where it might be expected. Serious wound infection requiring removal of all stitches occurred in two cases. Melena is noted in two cases only, but may have happened in others and not have been noted. There were but two cases of phlebitis. There was one case of acute dilatation of stomach and one of post-operative psychosis (paranoid). There was excessive vomiting in two patients and late vomiting in five. This late vomiting we have not been able to explain. It has always been relieved by a duodenal tube or lavage and by temporarily reducing the oral intake.

We have included in this series one case which at operation was thought to be a carcinoma of pylorus, and inoperable because of extensive glandular involvement, but three years have passed since the gastrojejunostomy was done and the patient is free of symptoms.

We know that two of the patients in this series later developed carcinoma. Such errors in diagnosis will probably always occur, but they are not as frequent as formerly.

Only one anterior gastrojejunostomy was done in these cases and that because of non-rotation of the colon.

Nitrous-oxide and ether were the most common anaesthetics, but in some of the perforations and in the dehydrated cases, infiltration alone or combined with gas was used. In considering the mortality and the post-operative complications in this series of cases, it is apparent that some form of lung pathology is most conspicuous. In the clean cases, wound infections and peritonitis have not been high and there was but one fatal hæmorrhage—a case of gastrectomy (Gibbon).

RESULTS OF OPERATIONS FOR CHRONIC GASTRIC AND DUODENAL ULCERATION

A STATISTICAL STUDY OF A THIRTY-YEAR PERIOD

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TO BEGIN with, let us frankly admit that one of the main reasons which prompted us to undertake this study was the fact that we approach an operation for ulcer, either gastric or duodenal, with less confidence in our ability to accomplish a cure through surgical measures, than in the case of the other common non-cancerous surgical lesions found in the abdomen. That we are not alone in this perhaps surprising position is attested by various readily ascertainable facts. If we inquire among professional friends as to their experience with the surgical treatment of gastric and duodenal ulcer, we are apt to find a good deal of dissatisfaction with end-results. Surely the published reports in current literature, even those from the best clinics, are not wholly satisfactory.

As showing the extremes to which this dissatisfaction has gone in certain quarters, let us quote from a personal letter recently received from Sir Cuthbert Wallace, surgeon to St. Thomas's Hospital, London. He writes, "I have never been very well satisfied with the operation of gastrojejunostomy for either duodenal or gastric ulcer, for I believe that there is only one thing that gastrojejunostomy can cure, and that is pyloric obstruction." He adds, "As most gastroenterostomies have to be kept on an alkaline diet, and as the same alkaline diet will keep the patient comfortable without operation, the surgeon had best stand aside."

Compare this attitude with that as shown by the published statistics from those clinics which report the highest percentages of cures, and one cannot fail to be impressed by the disparity between the two. What is the explanation of such a marked disagreement?

The great majority of surgeons will, we think, be inclined to believe that Wallace's view is entirely too pessimistic. On the other hand, such figures as those quoted by Balfour, Crile, Moynihan or Coffey are exceptional. Somewhere between these extremes must lie the answer to the above question, so far as the average surgeon is concerned.

In a previous paper dealing exclusively with duodenal ulcer, we pointed out several variable factors which may exercise considerable influence, favorable or unfavorable, upon both the immediate and late results in statistical studies of a similar nature. Let us enumerate some of the more important of these.

First comes the social status of patients operated upon. Obviously, private patients will, in general, be much better equipped, financially and intellectually,

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to take better pre- and post-operative care of themselves than ward patients. Private patients may be expected to be better operative risks, and in most cases their surgeons will have already passed their probation period. Secondly, a preponderance of certain races, negroes for instance, possibly owing to their well-known lack of resistance to abdominal affections, would probably exert an unfavorable influence upon one's statistics. Thirdly, one series may contain only the private cases of one or two expert surgeons, while another may include the work of a group of surgeons, skilled and less skilled, such as members of the resident hospital staff. Fourthly, the period covered by statistical studies may be a very selected one, or of comparatively recent date. It may be taken for granted, we believe, that surgery for gastric and duodenal ulceration has greatly improved between 1915 and 1930, as compared with the corresponding period between 1900 and 1915, and a lower immediate operative mortality may be expected. Moreover, a series whose end-results are drawn from patients operated upon during the past fifteen years must necessarily show better figures than a series made up of patients who may have had twice as long to develop recurrences or complications. Fifthly, the end-results in one series may have been carefully investigated, and controlled in many instances by personal examination, while in another they may be based on quite meager data.

In the hope of finding a possible explanation of this unsatisfactory state of affairs, we have made a comprehensive review of the results obtained in the Johns Hopkins and in the Union Memorial Hospitals over the period between 1900 and 1930. The cases include both private and ward patients and in one, Johns Hopkins, the ward patients were both white and colored. The operations included in this series represent the work of about thirty surgeons of varying experience.

The study of end-results was made in 1927, of all patients operated upon between 1900 and 1925, so that the shortest interval between operation and report is two years. The patients operated upon between 1925 and 1930 are used only in the estimation of operative mortality. Seventy-seven per cent. of the patients operated upon between 1900 and 1925 replied to our questionnaire and of many of these we were able to get further information from their family physician, or by personal examination. For the latter we are largely indebted to Dr. Walter Hughson, of the Hopkins staff.

The choice of operation depended upon the findings after the abdomen had been opened. It is our invariable practice never to begin an operation with a preconceived idea as to just what we will do, irrespective of the findings. The effort is made at all times to make use of that particular operative procedure which seems best adapted to bring about the desired result in the particular case under operation. In general, however, pyloroplasty, preferably with excision of the ulcer, is the operation of choice when practicable, and gastroenterostomy is reserved for those cases with an obstructed pylorus—since in the presence of a patent pylorus, its results in our hands have proved rather uncertain. One great advantage that pyloro-

plasty has over gastroenterostomy, or the simple ulcer-excision operations, lies in the division of the pyloric sphincter, which is thus, for the time being, put out of action. This effectually does away with reflex spastic pylorospasm so productive of pain and retention phenomena.

In the previous communication, to which we have already referred, we used the classification "died within six months after operation," rather than the more customary "died in hospital"—an extension of the operative period which appreciably increased the apparent rate of operative mortality. We did this because our preliminary survey showed that an unexpected number of deaths occurred during this period, and that the majority of these deaths were traceable either directly or indirectly to the operation. However, since this tabulation caused some confusion in the minds of many who had shown interest in the paper, and gave rise to erroneous impressions, we have here followed the method usually employed, designating as "operative mortality" only those deaths which occurred in the hospital. We still believe, however, that it would be more accurate to take account of this "delayed operative mortality," as differentiated from the immediate or hospital operative mortality.

There were 737 patients operated upon in the two hospitals between 1900 and 1930, of whom 110, or 14.9 per cent. had perforated prior to operation. The operative mortality in the presence of perforation was markedly increased, being 23.6 per cent. as contrasted with 8.6 per cent. for the non-perforated group.

Perforated Ulcers.—Of the 110 perforated ulcers, fifty-six were gastric, fifty-three duodenal and one was a post-operative marginal ulcer. The operative mortality in the gastric ulcer group was 26.8 per cent., and in the duodenal group, 18.9 per cent. Of the thirty-four traced survivors, thirty-one, or 91.1 per cent., had been relieved of their previous ulcer symptoms. There seems to be a slightly greater tendency for gastric and pyloric ulcers to perforate (17.3 per cent.) than for duodenal ulcers (13.5 per cent.). When the miscellaneous procedures only were used (forty-seven cases), the mortality was 29.8 per cent. With gastroenterostomy added, in twenty-eight cases, the mortality was 20 per cent. Excision or suture, with pyloroplasty, resulted also in 20 per cent. mortality, while in the nine cases in which partial gastrectomy was done, the mortality was 11.1 per cent.

The mortality rate in this series of 110 cases is high (28.8 per cent.), influenced largely by the fact that in the earlier years perforated ulcers were not brought to the surgeon until very late.

Chronic Ulcers.—There were 627 chronic ulcers operated upon. Of these, 268 were gastric, 339 were duodenal and twenty were post-operative marginal ulcers. The mortality for the whole group was 8.6 per cent., and 83.9 per cent. of the 330 traced cases were improved by the operation. The operative mortality in 268 cases of gastric ulcer was 9.7 per cent., and 80.8 per cent. were benefited by the operation. The operative mortality for 339 cases of duodenal ulcer was 7.1 per cent., while 86.4 per cent. were benefited.

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TABLE I
Operations for Gastric, Duodenal and Marginal Ulcer,
The Johns Hopkins Hospital and the Union Memorial Hospital.
1900—1930

	Number	Died in hospital	1925-1930 Cases not traced	1900-1925 Cases no reply	New total traced	Living well	Living improved	Living unimproved	Died Unimproved	Previous symptoms benefited by operation	Previous symptoms not benefited by operation
Perforated	Gastric*	56	15 26.8%	13	9	19	10 52.6%	5 26.2%	1 5.2%	1 15.6%	3 15.8%
	Duodenal	53	10 18.9%	21	7	15	10 67%	4 26.6%	0	1	0
	Marginal	1	1								
Chronic	Totals	110	26 23.6%	34	16	34	20 58.8%	9 26.5%	1 3.0%	4 11.7%	3 8.9%
	Gastric	268	26 9.7%	47	49	146	82 56.2%	24 16.4%	9 6.2%	31 21.2%	28 19.2%
	Duodenal	339	24 7.1%	92	39	184	115 62.5%	36 19.6%	18 9.8%	15 8.2%	25 15.6%
All Ulcers	Marginal	20	4 20.0%	16							
	Totals	627	54 8.6%	155	88	330	197 59.7%	60 18.2%	27 8.2%	46 13.9%	53 16.1%
	Totals	737	80 10.9%	189 25.6%	104 14.1%	364	217 59.6%	69 18.9%	28 7.7%	50 13.7%	56 15.4%

* Pyloric ulcers, even those extending into the duodenum, are here classed as "gastric ulcers."

TABLE II
Results of the Different Operations for Duodenal Ulcers—Chronic

	Number	Died in hospital	1925-1930 Cases not traced	1900-1925 Cases no reply	New total traced	Living well	Living improved	Living unimproved	Dead Im-proved	Unim-proved	Symptoms benefited by operation	Symptoms not benefited by operation
Miscellaneous operations	9	2 22.2%	2	1	4	1	0	3	0	1	1	3
Gastroenterostomy	170	18 10.6%	72	13	67	42 62.7%	13 19.4%	4 6%	8 11.9%	3	60 89.6%	7 10.4%
Pyloroplasty	149	4 2.7%	17	22	106	67 63.2%	22 20.8%	10 9.4%	7 6.6%	4	92 86.8%	14 13.2%
Partial gastrectomy	11	0 0%	1	3	7	5	1	1	0	0	6	1
Totals	339	24 7.1%	92 27.1%	39 11.5%	184	115 62.5%	36 19.6%	18 9.8%	15 8.2%	159 86.4%	159 86.4%	25 15.6%

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There were four deaths after twenty operations for post-operative gastro-jejunal ulcer.

In the 268 cases of chronic gastric ulcer operated on, there were seventeen in whom such miscellaneous operations as simple excision, atypical resections, *etc.* were performed. Of these patients five died, a mortality rate of 29 per cent. These, according to their histories, were unusual cases; the patients were often very ill, and for some reason or other it was thought either impossible or inadvisable to do one of the more typical operations. In ninety cases, gastroenterostomy was done, with three deaths, or 3.3 per cent. In 102 cases pyloroplasty was done, with nine deaths, or 8.8 per cent. Partial gastrectomy, more or less extensive, was done in fifty-nine cases, with nine deaths, or 15.3 per cent.

In 339 cases of chronic duodenal ulcer, there were nine miscellaneous atypical operations performed, with two deaths, or 22.2 per cent. Gastroenterostomy was done in 170 cases, with eighteen deaths, or 10.6 per cent.; pyloroplasty in 149 cases, with four deaths, or 2.7 per cent. There were no deaths following partial gastrectomy for this condition.

Taking the operations as such, without regard to the lesion which prompted its performance, we find that gastroenterostomy was performed on 260 patients, with 8.1 per cent. mortality. Pyloroplasty was done on 251 patients, with 5.2 per cent. mortality, while the mortality in seventy gastrectomies was 12.9 per cent. The subsequent results after gastroenterostomy or pyloroplasty are remarkably parallel. After either operation, exactly 61.1 per cent. of the patients were living and well, while a total of 85.8 per cent. were benefited by pyloroplasty and 84.1 per cent. by gastroenterostomy. An apparent difference is found in the figures for later deaths. There were 17.7 per cent. of these in the gastroenterostomy group and 9.9 per cent. in the pyloroplasty group.

When these operations are studied in their application to gastric or duodenal ulcers, more striking differences appear. Gastroenterostomy benefited 89.6 per cent. of the patients operated on for duodenal ulcer, and pyloroplasty 86.8 per cent. But, when used for gastric ulcer, gastroenterostomy improved only 76.1 per cent., while pyloroplasty improved 83.9 per cent. In this connection, we note that partial gastrectomy for gastric ulcer, although having 15.3 per cent. mortality, benefited 88.2 per cent. of its survivors.

The accompanying tables speak for themselves. Anyone sufficiently interested will note some interesting facts brought out by the figures. We might point out various features which we believe have a bearing on the operative mortality. As has been stated above, the mortality for the whole group of chronic ulcers is 8.6 per cent. This includes seventy resections with 12.9 per cent. mortality. Eliminating these, and the various miscellaneous operations, which we have seen are accompanied by a high mortality, we have left 260 gastroenterostomies with an 8.1 per cent. mortality and 251 pyloroplasties with a 5.2 per cent. mortality. In the twenty-one deaths making the gastroenterostomy mortality are thirteen anastomosis obstructions. If these be

TABLE III
Results of the Different Operations for Pyloric and Gastric Ulcers—Chronic

	Number	Died in hospital	1925-1930 Cases not traced	1900-1925 Cases no reply	New total traced	Living well	Living improved	Living unimproved	Dead Im-proved	Dead Unim-proved	Symptoms benefited by operation	Symptoms not benefited by operation
Miscellaneous excisions and wedge resections	17	5 29.4%	1	1	10	3	2	2	3	1	6	4
Gastroenterostomy	90	3 3.3%	28	13	46	27 58.7%	4 8.7%	3 6.5%	12 26.1%	4	35 76.1%	11 23.9%
Pyloroplasty	102	9 8.8%	7	30	56	32 57.1%	11 19.6%	4 7.2%	9 16.1%	4	47 83.9%	9 16.1%
Partial gastrectomy	59	9 15.3%	11	5	34	20 58.8%	7 20.6%	0	7 20.6%	3	30 88.2%	4 11.8%
Totals	268	26 9.7%	47 17.5%	49 18.3%	146	82 56.2%	24 16.4%	9 6.2%	31 21.2%	12	118 80.8%	28 19.2%

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TABLE IV
Deaths After Operation for Duodenal Ulcer—Chronic

	Died in hospital	Died during first six months after operation	Late deaths after six months	Died of unrelated causes. Improved by operation	Died of related causes—cancer, hemorrhage, or after another operation	Cause of death unknown
Gastro-enterostomy	Hemorrhage Obstruction Emboli Cardiac Shock 1 14 1 1 1 18	Obstruction 1	7	Sarcoma Carc. sigmoid Angina Suicide 1 1 1 1 4	Following operation for marginal ulcer—1	2
Pyloroplasty	Streptococcus peritonitis Empyema Cardiac Pulmonary 1 1 1 — 4	Empyema Nephritis Not known 1 1 1 — 3	4	Cardiac 2	1	1
Resection	None	None	None			
Miscellaneous procedures	Pneumonia 2	None	None			

eliminated for the sake of comparison, the mortality from gastroenterostomy would have been 2.9 per cent. This is interesting in comparison with the 5.2 per cent. for pyloroplasty—in the majority of which death seems to have been due to some form of pulmonary complication. At any rate, these last figures give us a hypothetical base line which we may reckon as an expected death rate following operations on the stomach and duodenum.

It will be noted that the fourteen deaths from obstruction followed gastroenterostomy for duodenal ulcer. In one the obstruction occurred in the sigmoid flexure, but in the remainder it was related to the actual anastomosis. The onset of the symptoms of obstruction was known in seven of these and the average period before onset was nine days. All these patients were re-operated upon after an average period of five days, following the onset of the obstruction. Among the more frequent conditions found as apparent causes of obstruction were dense inflammatory reaction and edema about the anastomosis itself. In other instances, there was noted constriction of the anastomosis by the transverse mesocolon, and gastric dilatation.

That the operative mortality for ulcer has been decreased during recent years is evident from the following figures. In the Johns Hopkins Hospital, between 1925 and 1930, there were 112 chronic ulcers operated upon. Thirty-seven were gastric, seventy were duodenal and five were post-operative marginal ulcers. The mortality for this group was 3.7 per cent. Gastroenterostomy, with or without excision of the ulcer, was performed much more frequently, being employed in eighty-four of the cases. The mortality from operation was as follows:

Gastroenterostomy	84 cases—mortality	2.4 per cent.
Pyloroplasty	12 cases—mortality	0 per cent.
Partial gastrectomy	7 cases—mortality	14.3 per cent.
Miscellaneous operations	4 cases—mortality	0 per cent.
Operations for marginal ulcer	5 cases—mortality	20.0 per cent.
<hr/>		
112 cases—mortality		3.7 per cent.

Sixty gastro-enterostomies for duodenal ulcer were performed, with one death.

The distribution of the later deaths is instructive. Following an operation for gastric ulcer, 21.2 per cent. subsequently died, while only 8.2 per cent. had died following their operation for duodenal ulcer. If studied more specifically, the following figures are arrived at:

Later deaths following pyloroplasty	for duodenal ulcer—	6.6 per cent.
Later deaths following gastroenterostomy	for duodenal ulcer—	11.9 per cent.
Later deaths following pyloroplasty	for gastric ulcer	—16.1 per cent.
Later deaths following partial gastrectomy	for gastric ulcer	—20.6 per cent.
Later deaths following gastroenterostomy	for gastric ulcer	—26.1 per cent.

Six of eleven later deaths (after six months), following operation for duodenal ulcer, are known to have been unrelated to the previous ulcer or

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operation. Two of these patients died following a later operation and in three the cause of death was unknown.

Twelve of thirty later deaths, following operation for gastric ulcer, are known to have been unrelated to their previous ulcer or operation. Ten died of a related cause and in eight it was unknown.

In other words, 54 per cent. of the later deaths following operation for duodenal ulcer, as compared with only forty per cent. in the gastric ulcer group, were unrelated to the ulcer. The difference, allowing for the deaths from unknown causes, seems to be attributable to failure of the operation to cure gastric ulcer, to prevent reulceration, or carcinoma. This opinion is supported by the following facts. In pyloroplasty for gastric ulcer, the ulcer is often removed. In a partial gastrectomy, a larger ulcer is removed, but in this larger ulcer an undiscovered carcinoma may already exist. On the other hand, gastroenterostomy, unless the ulcer is removed at the same time, allows a potential source of later danger to remain relatively unmolested.

Four deaths from carcinoma occurred out of the thirty after operation for gastric ulcer. If, for the sake of comparison, these four be considered as carcinoma at the time of operation and dropped from the series, we still find gastric ulcer less amenable to surgical treatment than is duodenal ulcer. There is still some factor other than the potentiality toward carcinoma that predisposes to poorer results. It happens in this series that tuberculosis was related to gastric to a far greater extent than to duodenal ulcer. Including perforated ulcers, there were seven such cases. Five of the seven patients died within a year and two died after several years. May it not be that tuberculosis is frequently one cause of the less satisfactory results following operation for gastric ulcer?

SUMMARY

Seven hundred and thirty-seven cases of ulcer of the stomach and duodenum were operated on in the Johns Hopkins Hospital and Union Memorial Hospital between 1900 and 1930. One hundred and ten were operated upon after perforation, with an operative mortality of 23.6 per cent. The mortality in all operations for chronic ulcer was 8.6 per cent.

Of the chronic ulcers, 268 were gastric and 339 duodenal. There were twenty operations for post-operative marginal ulcer in the chronic group.

The operations included such miscellaneous procedures as excisions, with knife or cautery, wedge and sleeve resections, either with or without a gastroenterostomy, simple gastroenterostomy, pyloroplasty, with or without excision, and partial gastrectomy. The miscellaneous procedures were applied to those cases in which pyloroplasty or gastroenterostomy were for some reason contraindicated. Pyloroplasty was the operation of choice for ulcers of the duodenum, pylorus or antrum, when the ulcer could be included in the pyloroplastic incision and when the duodenum could be satisfactorily mobilized. Partial gastrectomy was occasionally used for duodenal ulcer and more commonly for ulcers of the body of the stomach, when conditions warranted

TABLE V
Deaths After Operation for Gastric Ulcer—Chronic

	Died in hospital	Died during first six months after operation	Late deaths after six months	Died of unrelated causes, Improved by operation	Died of related causes—cancer, haemorrhage, or after another late operation	Cause of death unknown
Gastro-enterostomy	Pulmonary 2 Unknown 1 — 1 3	Not known 1	11	Cardio-renal 3 Cerebral haemorrhage 1 — 1 4	Gastric spasm 1 Haemorrhage 1 Peritonitis 1 Carcinoma 2 — 1 5	2
Pyloroplasty	Suture necrosis 1 Pulmonary 7 Haemorrhage 1 — 1 9		9	Cardio-renal 4 3	Pulmonary Tb. 2 2	3
Resection	Operative error 1 Suture necrosis 1 Pulmonary 2 Obstruction 3 Not known 2 — 2 9		7	Accidents 2 Cardio-renal 1 — 1 3	Carcinoma 2 2	2
Miscellaneous procedures	Pulmonary 3 Haemorrhage 2 — 1 5		3	Accident 1 1	Following abdominal operation—1 1	1

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the more radical procedure. Gastroenterostomy was used for ulcers of the lesser curvature and fundus when partial gastrectomy was not practicable; for ulcers of the pylorus and duodenum when difficult mobilization or the presence of excessive scar tissue precluded pyloroplasty.

The operative mortality for this series approximated that of most hospital series covering similar periods, and performed under similar circumstances. The figures by operations are as follows: miscellaneous operations of expediency, 26.9 per cent.; gastroenterostomy, 8.1 per cent.; pyloroplasty, 5.2 per cent. and partial gastrectomy, 12.9 per cent. The operative mortality in eighty-four cases of gastroenterostomy in the Johns Hopkins Hospital between 1925 and 1930 was 2.4 per cent. The operative mortality following pyloroplasty for duodenal ulcer was 2.7 per cent. These operations were done by men of varying experience, from assistants in training, to older experienced surgeons.

The end-results of these operations also correspond closely to those of most similar series—84.6 per cent. benefited by the operation. Duodenal ulcer yielded better results than gastric, even after allowance is made for those gastric ulcers known to have died later of carcinoma.

DISCUSSION OF PAPERS ON MORTALITY AND LATE RESULTS OF OPERATIONS FOR GASTRIC AND DUODENAL ULCERS, pp. 545-631.

DR. JOHN DOUGLAS, of New York, remarked that this symposium must be of great value in clarifying the question of both mortality and end-results of the surgical treatment of gastric and duodenal ulcer. Surgeons in New York are particularly grateful for it because from a certain group there has come the strongest advocacy of the radical treatment for these conditions, equaled only by that from several European continental clinics. This advocacy has been strengthened and fostered by the publication and the emphasis of the poor results of the non-radical procedures, and it seemed to him that the assembling of all of these results can do more than anything else to make the real subject clear. The emphasis on the poor results of non-radical operations has gone so far, at least in New York, that it has discouraged the internists and gastroenterologists from advocating any surgery in most of these cases.

He wished to present a series of tables based on 375 gastric and duodenal ulcers that had been operated on by the group of surgeons in St. Luke's Hospital in New York during the seven years previous to the year 1925, showing the operative mortality and also end-results.

Of the 225 cases of duodenal ulcer, a posterior gastroenterostomy alone was done on 135 with four deaths, giving 2.9 per cent. mortality. In the five-year follow-up of this group of cases there were sixty-eight. Of these, eight showed symptoms, with 88 per cent. of result A. Where there had been an excision or infolding, there were seventeen cases, one showing symptoms; but that group was too small to indicate anything. The same is true of exclusion of the pylorus with gastroenterostomy.

Partial gastrectomy for duodenal ulcer was done in only two cases. Pyloroplasty, twenty-two cases with only 60 per cent. of result A. That is, the five-year follow-up of the cases on which pyloroplasty was done was not so satisfactory as those on which a gastroenterostomy was performed. Nor was it so good as the results of pyloroplasty reported from other hospitals.

In the twenty-four perforated cases, where there was repair of the perforation alone, there were four deaths and, of the ten followed, 75 per cent. showed satisfactory results. This series is too small to afford any conclusion.

JOHN DOUGLAS

Where a gastroenterostomy has been done in ten of the cases, in addition to closure of the perforation, 83 per cent. showed satisfactory results. In only one case was a pyloroplasty done after perforation.

Of the non-perforated duodenal ulcers, in all the various operative procedures, there were eleven deaths in 190 cases, or 5.7 per cent. In 135 cases in which gastroenterostomy alone was done, four deaths, or 2.9 per cent. In the perforated cases we had seven deaths in thirty-five cases, or 20 per cent. (See Table I.)

TABLE I

<i>Duodenal ulcers</i>	<i>No. of cases</i>	<i>Deaths</i>		<i>5-year F-up.</i>	<i>Symptoms</i>	<i>Per cent "A" results</i>
		<i>Non-perforated</i>	<i>—Perforated</i>			
Post. gastroenterostomy	135	4(4-0)		68	8	88
Post. with excision cautery or infolding	17	3(3-0)		4	1	75
Post. with pyloric occlusion	3	0		1	1	—
Excision cautery or infolding	11	0		9	2	78
Pyloroplasty	22	3(3-0)		10	4	60
Partial gastrectomy	2	1(1-0)		1	0	100
Repair of perforation	24	4(0-4)		8	2	75
Repair of perforation with gastroenterostomy	10	3(0-3)		6	1	83
Repair of perforation with pyloroplasty	1	0		1	0	100
Total	225	18(11-7)		108	19	

As far as the results were concerned, of 108 cases followed up, 82.4 per cent. showed an A result. Results B are the ones in which there were occasional symptoms, and of those there were three in 108 cases. Result C are those cases in whom symptoms appeared with indiscretion in diet. Of these there were five in 108 cases, and eleven of 108 cases were grouped as result D, or bad results. (See Table II.)

TABLE II

<i>Duodenal ulcers</i>			
Deaths	(non-perforated cases)	11 in 190 cases	5.7%
Deaths	(non-perforated cases after gastroenterostomy)	4 in 135 cases	2.9%
Deaths	(perforated cases)	7 in 35 cases	20.0%
Cures	(result "A")	89 in 108 cases	82.4%
Symptoms	(result "B" and "C")		
	(1) occasional symptoms	3 in 108 cases	3.0%
	(2) symptoms with indiscretion in diet	5 in 108 cases	4.3%
Symptoms	(result "D")	11 in 108 cases	10.1%

In the gastric series both the mortality is higher and the end-results are not so good. Gastroenterostomy alone was done in only sixty-two of these cases with four deaths or 6.4 per cent., with an A result in 78 per cent. of cases.

With excision, cautery or infolding of the ulcer, in addition to gastroenterostomy, there were twenty-four cases, and in that group only 60 per cent. showed satisfactory results. The other groups are too small to be of very great value. Partial gastrectomy was done in twenty-five cases, and in these, twelve were followed and three gave symptoms, or 75 per cent. good results. There were two deaths—a mortality of 8 per cent.

Of mid-gastric resection there were seven cases. In the three followed we had satisfactory results.

There were only four cases of closure of perforation with gastroenterostomy, with two deaths. Closure of perforation without gastroenterostomy but with cautery or

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excision of the ulcer showed eleven cases with no deaths. We were only able to follow six such cases and in those the results were satisfactory. (See Table III.)

TABLE III

	No. of cases	Deaths	5-Year F-up.	Symptoms	Per cent "A" results
		Non-perforated — Perforated			
<i>Gastric ulcers</i>					
Gastroenterostomy.....	62	4(4-0)	27	6	78
Gastroenterostomy with excision cautery or infolding.....	24	7(7-0)	10	4	60
Gastroenterostomy with pyloric oc- clusion.....	2	0	1	0	100
Gastroenterostomy with pyloro- plasty.....	1	0	1	0	100
Excision or cautery of ulcer.....	10	1(1-0)	5	0	100
Jejunostomy.....	1	0	1	0	100
Partial gastrectomy.....	25	2(2-0)	12	3	75
Transgastric resection.....	4	0	0	0	—
Mid-gastric resection.....	7	3(3-0)	3	0	100
Closure of perforation with gastro- enterostomy.....	4	2(0-2)	1	0	100
Closure of perforation with or with- out excision or cautery.....	11	0	6	0	100
Total.....	151	19(17-2)	67	13	

In the non-perforated ulcers where extensive resection was done, there was 12.5 per cent. mortality. In the non-perforated cases where gastroenterostomy was done, 6 per cent. mortality. The result in these cases was fifty-four in sixty-seven cases, or 81 per cent. result A. Result B, 4.5 per cent. Result C, with indiscretion in diet, 9 per cent. Result D, 6 per cent. (See Table IV.) While the results leave much to be desired,

TABLE IV

<i>Gastric ulcers</i>			
Deaths	(non-perforated)	17 in 136 cases	12.5%
Deaths	(non-perforated cases after gastroenterostomy)	4 in 62 cases	6.4%
Deaths	(perforated cases)	2 in 15 cases	13.3%
Cures	(result "A")	54 in 67 cases	81.0%
Symptoms	(result "B" and "C")		
	(1) occasional symptoms	3 in 67 cases	4.5%
	(2) symptoms with indiscretion in diet	6 in 67 cases	9.0%
Symptoms	(result "D")	4 in 67 cases	6.0%

it must be remembered that the majority of the patients were ward cases who could with difficulty be controlled after leaving the hospital. If their diet and methods of life, eradication of focal infection, care of the teeth, etc., could have been looked after I am sure the results would have been still better, as I believe such after-care is essential in obtaining the best results after any form of operation for gastric or duodenal ulcer.

A word about the marginal ulcers. Of the total number of cases diagnosed from 1916 to 1929 there were twenty-two. Those confirmed by some method, X-ray, operation or autopsy, twelve. Primary operation done in St. Luke's Hospital, twelve. Confirmed with primary operation in St. Luke's Hospital, five.

So, included in this series up to 1925 there were only three in the 175 cases followed, or 1.6 per cent. (See Table V.)

ARTHUR D. BEVAN

Studying this group, which is of particular interest to me, there were five cases which were diagnosed after partial gastrectomy. Of these five cases, diagnosis was confirmed by operation or autopsy in three, showing that the gastrectomy does not prevent the formation of marginal ulcer.

TABLE V

Gastrojejunal, jejunal or marginal ulcers

Total cases diagnosed from 1916 to December 1929.....	22
Total cases diagnosed and confirmed from 1916 to December 1929.....	12
Total cases diagnosed with primary operation here.....	12
Total cases diagnosed and confirmed with primary operation here.....	5
Total cases diagnosed with primary operation elsewhere.....	7
Total cases diagnosed included in series up to 1925.....	3 in 175
Total cases diagnosed after partial gastrectomy.....	5
Total cases diagnosed and confirmed after partial gastrectomy.....	3

DR. ARTHUR D. BEVAN, of Chicago, remarked that peptic ulcer is a very common disease. The best statistics that we have now, those of Carl Hart, show that it occurs in from 10 to 12 per cent. of the adult population. In the adult, from twenty to forty-five years of age, where post-mortems are carefully made, more than half of these ulcers are healed, less than half are open ulcers. In other words, it has been proven very definitely that there is a strong tendency to spontaneous cure. These two facts should be kept in mind in studying this problem. The piece of joint research that Doctor Sippy and his associates and my associates and myself made in the period from 1915 to 1925 included 2,056 ulcer cases. It was a piece of scientific research between the medical and surgical departments without any preconceived conception or idea as to what the result would be. Sippy was enthusiastic about the method of treatment which he was introducing. He had the general conception that Cruveilhier had, and which he presented a hundred years ago when peptic ulcer was first accurately presented to the medical profession, that it was due to corrosion or digestion by gastric juice, and he had the conception that peptic ulcer was due to a combination of several causes and this we finally formulated in the algebraic problem that X plus Y plus Z equals peptic ulcer, that the X was the essential cause and was represented by gastric juice containing free hydrochloric acid and pepsin, that the Y was a lesion of the mucous membrane where the mucous membrane or other coats of the stomach were so injured that they could be digested by the gastric juice, that the Z was what we might call the susceptibility of the individual to ulcer. We know that there is a very marked hereditary influence. We know that other conditions like anaemia, syphilis and tuberculosis predispose to ulcer. It is nonsense to say that we do not know anything about the etiology of peptic ulcer. An enormous amount of work has been done on this subject, as much possibly as on any problem in medicine. The most exhaustive and the most reliable article on the etiology and pathology of peptic ulcer is that of Hauser in the *Henke-Lubarsch* series on "Pathologic Anatomy and Histologie." We know quite as thoroughly what the etiology of peptic ulcer is as we do the etiology of ulcer of the leg. The conception was carried out in our study that in the treatment the elimination of the effect of the free hydrochloric acid as accomplished by the Sippy treatment is essential, and that rest is, of course, important, and that simple bland diet must remove food traumas.

The conception must be perfectly clear to our mind now that no matter whether a peptic ulcer is treated by medical management, by a lesser operation such as a gastroenterostomy or by a resection, that the same factors that produced the peptic ulcer in the first case may lead to a recurrent ulcer. There is no assurance that by resection one is going to cure a peptic ulcer.

A German colleague said that after a patient with a great tendency to recurrent

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ulcer had been operated on three or four times and finally almost the total extent of the stomach had been resected and the patient had no further symptoms, "Of course if you have an ulcer of the leg and you amputate the thigh, your ulcer of the leg is gone." But there is always that tendency, and I think we to-day should realize that no matter what the treatment is, medical, gastroenterostomy or resection, there is always the prospect of a recurring ulcer.

In this group of 2,056 cases we operated on only about 10 per cent. We operated on those that were transferred to us by the medical department, the admitted medical failures. I would say to-day that in a similar series we would operate on probably twice as many.

Looking at this problem in a judicial way I would say this: that the medical man to-day who does not see a fair surgical indication in 20 per cent. or more of his cases is not doing the best by his patients. I would also say that the surgeon who does not realize that there is a strong tendency to cure spontaneously, and a very marked tendency and prospect of cure under proper medical management in probably 80 per cent. of the cases is not doing the best that he can for his patient.

Of course there will always be the difficult cases to be handled, and we must recognize the main central idea that there is such a lesion as peptic ulcer disease, that we haven't to deal simply with a single lesion, that it is a tendency which must be handled.

PROFESSOR GUNNAR NYSTROM, of Uppsala, Sweden, said, to illustrate what Doctor Bevan had said, he would report a case of recurrent duodenal ulcer in a forty-seven-year-old man, callus duodenal ulcer, resection of the antrum of the stomach, modification of Polya. While the function was not satisfactory, a gastroenterostomy was done one month after operation. After five months the patient called again. He had then a jejunal ulcer in the abdominal wall. The ulcer was excised, a malformation here and the outlet here. All went well. After eight months the man came in presenting a large jejunal ulcer just opposite the outlet. The affected loop was removed and an enteroanastomosis made; the stomach was resected so that only about one-third of it was left and a new gastroenterostomy was made.

Investigation about acidity showed that the gastric juice was taken out by the gastric fistula. The acidity rose just above to normal conditions. It was investigated every few hours through the fistula. The acidity rose slowly. The pepsin continued to be secreted after operation. This is in accordance with investigations by Perma that in fourteen cases only three showed acidity, four cases lower rates of acidity, and half the cases normal rates of hydrochloric acid. This goes to show that the opinion based on investigation that the removal of the distal part of the stomach is going to extinguish the production of gastric peptic juice is erroneous. Three years after this operation the man called again presenting two new jejunal ulcers, one in the upper part and one in the lower part. He was compelled to make another resection and made a new gastroenterostomy and with good success for these months. He did not know how it would be in the future.

This is in accordance with the rates of the recurrences of jejunal ulcer after their different operations. Jejunal ulcer follows in about 3 per cent. of gastroenterostomies in Germany. Less than 1 per cent. resections. The number of occurrences after resection has increased in the last year so it is possible that the rate will exceed 1 per cent., thus being about one-third of the number of recurrences of gastroenterostomy.

DR. JOSEPH C. BLOODGOOD said that for years physicians and surgeons had discussed the medical and surgical treatment of gastric ulcer without arriving at any definite conclusions. Frequently each has been highly prejudiced in favor of his own line of treatment. The results of surgical treatment had been shown this morning. They are not entirely satisfactory. In some instances they may be regarded as disappointing. The gastroenterologist and medical men should now present their side of the discussion after a number of cases have been followed carefully a sufficient length of time.

In the discussion of gastroenterostomy two things are striking; first, technic has

not been mentioned, and second the term vicious circle has not been employed. Such wide variations in the number of cases of obstruction, which formerly would have been referred to by the rather mystical term vicious circle, must be dependent somewhat upon variations in technic. Obstructions at the gastro-enterostomy orifice are occurring with decreasing frequency. The introduction of the posterior, no or short-loop, gastroenterostomy had much to do with this. One of the most important factors in its prevention is suturing the mesocolon high on the stomach, so that, if œdema occurs in the mesocolon, the stomach and not the suture line or the small intestine will be compressed. Obstruction can be prevented by suturing the stomach high. In cases upon which he had had to operate for obstruction or had seen operated upon, œdema, causing a rigid mesocolon, had been the cause in the majority of cases.

This œdema had been due apparently to mild infections. He knew that he was treading on debatable grounds when he spoke of clamps, but he believed that they prevent soiling, which may be the cause of a mild infection with œdema. He had seen no harm from using clamps. They facilitate the performance of the operation and render it clean.

Vicious circle clothes high intestinal obstruction with a certain air of mystery to which it is not entitled.

DR. WILLIAM J. MAYO, of Rochester, Minn., It is interesting that at a meeting of the American Surgical Association thirty years ago a remarkable contribution to the subject of duodenal ulcer was made by the president of the Association, Dr. Robert Weir. I perhaps remember it well because this was the first meeting of the Association I had attended as a Fellow, having been elected to fellowship the year before. Doctor Weir's presidential address was based on a summary of all the reported cases of perforated duodenal ulcer up to that time, a total of fifty-one, and he emphasized what now is known to all; namely, the relation of the symptoms that preceded the perforation to the condition that was found at operation. He brought out clearly the point of prolonged hyper-acidity, the relief obtained by taking food, and those classical symptoms that we now know well. I had seen a few cases of acute duodenal perforation before this time. It is interesting that in the first two cases in which we operated for acute perforation of the duodenum the pre-operative diagnosis was acute appendicitis. It so frequently happens that in the perforations of duodenal ulcers the duodenal content which escapes into the peritoneal cavity gravitates into the right inguinal fossa. It was only as we explored in these cases and found the appendix normal that we traced upward and found the perforated duodenum.

Judging from what has been brought out to-day, surgeons have reached something resembling unanimity of opinion regarding operations on duodenal and gastric ulcers. First, a considerable percentage of patients with duodenal ulcer get along very well if they are so situated that they can carry out the dietetic régime that is advised. Unfortunately many patients, because of poverty or nature of employment, are not able to care for themselves properly and must come to operation early. Also in many cases in which surgical treatment should be given, it is delayed, to the disadvantage of the patient by prolonged medical treatment, and repeated "cures." The patients with perforation, hæmorrhage, obstruction, and conditions which result in pain, malnutrition, and chronic dyspepsia should have surgical treatment.

When it is considered that the part of the duodenum that is involved in ulcer is functionally not of great importance, it seems a pity to advise removal of a large part of the healthy stomach for its cure. Few of us would ourselves submit to extensive gastrectomy for duodenal ulcer as a primary operation, or permit this operation to be performed on members of our families, inasmuch as local operations, gastroenterostomy, or partial duodenectomy, one or both, give so high a percentage of satisfactory results.

My opinion is still further strengthened by the fact that at the Clinic we are seeing about the same percentage of marginal ulcers after partial gastrectomy for ulcer of the duodenum that we saw following gastroenterostomy. The great majority of the operations of partial gastrectomy were not done at the Clinic, and we assume they were

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well done. An important consideration is that if gastroenterostomy is done, and later gives rise to trouble it can be disestablished. Many patients, relieved by gastroenterostomy in whom a gastrojejunal ulcer developed later have been found, on secondary operation, to have a soundly healed duodenal ulcer, without obstruction, and after the gastroenterostomy has been disestablished have gone for years without further symptoms.

I am sorry for the surgeon who again must resect a portion of the remaining gastric pouch, following partial gastrectomy for duodenal ulcer, to rid the patient of a secondary gastrojejunal marginal ulcer. We have had such experiences, not only once, but three or four times in the same patient.

There is rather general agreement between the clinician and the surgeon that ulcer of the stomach is a more serious disease which cannot always be distinguished from carcinoma.

About twenty-five years ago in a report of the first series of resections performed for gastric carcinoma in the Clinic it was shown that in more than 60 per cent. carcinoma probably had developed on a basis of gastric ulcer. In our later experience, although the percentage of cases in which the histologic examination of excised carcinomas of the stomach gives evidence of preceding ulcer varies in different series, evidence that gastric carcinoma has developed on some type of demonstrable precancerous disease, such as ulcer, is present in 25 per cent. Even those investigators who do not believe that carcinoma of the stomach often has its origin in ulcer, admit that carcinoma develops on a basis of ulcer in a percentage of cases, which Hurst, of Guy's Hospital, London, puts at about 20 per cent. It must be borne in mind that in a large percentage of cases the disease is so extensive when resection is done as to render it impossible to speak definitely of what preceded the carcinomas, just as it is a matter of common experience that purely clinical evidence as to the origin of carcinoma is likely to be fallacious.

DR. EUGENE H. POOL, of New York, presented some figures from his service at the New York Hospital. There has been surprising divergence in the reports in regard to immediate mortality. He was especially surprised to hear the statistics from one of the New York Hospitals and then to hear Doctor Felter's report of results. He reported only 2 per cent. mortality which is in striking contrast.

Doctor Pool's figures were 188 cases operated on in the wards by the staff of the second surgical division of New York Hospital for chronic duodenal ulcer. These do not include 142 acute perforated ulcers operated upon during the same period.

The follow-up findings are about the same in all these papers and statistics. They had in duodenal ulcer apparently 85 per cent. cures, but it is not on that feature he wanted to dwell. It is in regard to the deaths in simple gastroenterostomy, and here he had 119 cases, with nine deaths, or $7\frac{1}{2}$ per cent. almost identical with Doctor Gibbon. When he read his causes of death, Doctor Pool also was very much impressed with the similarity to his record.

The causes of death in my series are as follows: Subphrenic abscess; pneumonia; intestinal obstruction; general peritonitis; shock; suppurative pericarditis; delirium tremens; otitis media, followed by thrombosis of the lateral sinus and septicæmia.

A number of these cases could scarcely be attributed to the operation *per se*. Hanrahan naïvely said in the last paper, if one could eliminate the sixteen deaths due to obstruction it would cut down the mortality materially, but how can one, if those cases died in the hospital? How can one get away from the fact that of 119 cases, there were nine deaths or $7\frac{1}{2}$ per cent. mortality?

The sad part of this discussion he was reminded of when Dr. William Mayo was speaking. He sounded a warning against resection. All these records of mortality will be used as a strong argument by the advocates of resection for duodenal ulcer, but they must analyze their deaths as honestly as we have. If they have an otitis media in the hospital and the patient dies, he has got to be put down as dead. He did not believe they get away with such low mortality as they claim for extensive resections.

DR. J. SHELTON HORSLEY, of Richmond, Va., said that with very few exceptions, the cases in his paper were of patients that had been treated medically, unsuccessfully, and had consequently been operated upon. He operated more promptly on gastric ulcers than on duodenal ulcers.

He thought it rather unfortunate to have too sharp a distinction between the medical and the surgical treatment of peptic ulcer. They should go hand in hand. If the medical treatment can cure a peptic ulcer in a reasonable time, obviously it should be adopted, but why continue it indefinitely when no permanent curative results have been accomplished? On the other hand, when operation has been done, it is also obvious that medical treatment should be adopted to help the stomach recover. It is just as reasonable to use medical treatment, which consists largely in the regulation of diet to give the stomach rest, to assist in the recovery of a stomach that has been temporarily crippled by operation, as it is to use a splint on a fractured bone that has been accurately set until the bone has become strong again.

It seemed to him that the operation should be adapted to suit the lesion. Other things being equal, it is better to have two or three conservative operations with the prospect of a radical operation later in a very small percentage of cases, than it is to do an extremely radical operation such as a subtotal gastrectomy as a routine in all peptic ulcers.

DOCTOR GATEWOOD, of Chicago, remarked that several years ago Doctor Balfour called attention to the fact that their mortality was considerably reduced by pre-operative preparation. That was brought out in Doctor Gatewood's survey of these cases rather forcibly. In addition to that, it has been customary to give all of his patients a certain amount of post-operative medication. That is very much worth while if one expects to increase the percentage of cures after any type of gastric surgery.

DR. DONALD C. BALFOUR, of Rochester, Minn., thought there are three or four things that might be said in trying to summarize this symposium. In the first place, it is obvious that no operation will give perfect results in all cases of such a chronic disease as peptic ulcer, a disease in which the surgical management is usually carried out after all other methods of management have failed. The point which Doctor Douglas brought out in a very emphatic way was that recurrent ulcer may, and does, take place after any type of operation.

It is a fatal mistake to try to establish one operation for all types of peptic ulcer. So we finally end up with the fact that the best results that are being obtained by the surgeon who knows how to select the patient for operation and knows how to select the operation. He subscribed very emphatically to what Doctor Judd had said about the indications for pyloroplasty and excision. If one can get a good job done with that type of operation, the patient is in a position in which one would like to be oneself if one had a similar condition. If the patient should develop recurrence afterwards one is in a favorable position for carrying out further surgical procedure.

As far as the details of this symposium are concerned, leaving aside the mortality rates, there is a very definite conformity of results of gastroenterostomy in chronic duodenal ulcer. That is something one ought to remember because when the American Surgical Association presents such figures as these from various members, and they all run between 85 and 90 per cent., it is convincing evidence of what can be accomplished in chronic duodenal ulcer by indirect operation alone.

An impressive point in gastric ulcers was the extraordinary results which might take place in those lesions in which it would have been a very mutilating operation to remove the lesion anyway. Excellent results frequently follow an indirect operation alone. Seventy-nine per cent. of those patients reported themselves as being relieved of their symptoms, and in a great many of them the lesion had disappeared.

Finally, he thought the most fundamental point in this whole question of conservative versus radical procedures was this, that other things being equal, that is where the same surgeon is carrying out the different procedures, there will be more patients die

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following a partial gastrectomy as a primary operation than will develop recurrences, following a conservative procedure.

DR. FORDYCE B. ST. JOHN, of New York, remarked that satisfactory as the results have proven to be in this morning's consideration, the members of this organization especially cannot rest too comfortably upon those results. It would be of interest in the next five-year period to concentrate on what he had named intangible factors. He had been impressed in his study in following them in continuity with three factors: cases well six months previously will present symptoms at the given observation, temporary in many cases, but symptoms which one honestly cannot evade. Other cases will develop organic lesions such as marginal ulcer or hæmorrhage, or what not. The etiological factors in this group are becoming increasingly interesting and by no means always explained by stress and strain.

DR. JOHN H. GIBBON, of Philadelphia: thought this discussion had demonstrated the fact that the ability to perform one operation with facility does not completely equip a surgeon to deal with gastric and duodenal ulcer. Therefore, in this field as in all fields surgical judgment becomes of prime importance.

The next thing that has been brought out is the very high percentage of lung complications after these operations.

As to the rarity of jejunal ulcer, he remembered discussing this same question with the late Doctor Peck. Both agreed that probably jejunal ulcer might be due to the way in which the gastrojejunostomy was performed. At that time excision of the redundant mucous membrane of the jejunum was quite popular. They both agreed that this was a mistake and that the redundant mucous membrane of the jejunum should be used as a covering over the raw surface. Another important thing to remember is that the tight suturing, even with absorbable sutures, invites necrosis by cutting off the blood supply. Silk and linen sutures may play a part in the development of jejunal ulcers.

PHILOSOPHIC CONSIDERATIONS OF THE GALL-BLADDER*

BY CHARLES H. MAYO, M.D.
OF ROCHESTER, MINNESOTA

PROBABLY the most interesting period of medicine has been that of the last few decades. So rapid has been this advance, as new knowledge developed, that the truth of each year was necessarily modified by new evidence, making the truth an ever-changing factor.

My consideration of such advancement relates to the gall-bladder. As yet, we do not know why animals representative of certain types of life have gall-bladders and others do not, but it is probable that if we knew the full story of intake of food it would explain some of the purposes and some of the diseases of the gall-bladder. Members of the pigeon family do not have gall-bladders and neither have certain types of fish. Most animals which live on the direct products of the soil have gall-bladders, whereas the pocket gopher, which lives and feeds beneath the soil, does not have a gall-bladder. The rat, which possibly has an intestinal tract and liver much like that of the pocket gopher, is able to make much stronger bile than that made by the mouse, which has a gall-bladder. Animals which live on leaves during the summer and mosses and dried grasses beneath the snow in the winter do not have gall-bladders, and are types which mostly cast their horns or antlers. The elephant is also a leaf-eater and is minus a gall-bladder. Absence of the gall-bladder in the human being has been noted in thirteen instances and a double gall-bladder has been reported in eight instances.

Apparently the gall-bladder is attached to the right lobe of the liver. We now know from the chemical digestion of various portions of the liver that it is exactly on the division between the right and left lobes. There is no connection whatever between the circulation of the two lobes of the liver or between their ducts. The gall-bladder is supplied by the cystic artery of which the arterial tension is that of the circulation, whereas that of the arteries in the liver is low. The necessity for an excessive blood supply to this small sac is not evident at first thought. There are one or two lymph nodes on each of the hepatic ducts; if we know their normal size, their enlargement indicates infection or over work. The one or two lymph nodes on the common bile-duct are enlarged in the presence of disease of the gall-bladder, of ulcer of the duodenum, or of disease of the pancreas. The left lobe sometimes is wholly missing; then the gall-bladder is attached to the right lobe but is found near the median line of the body. If the right lobe is missing, then the compensatory hypertrophy which occurs when either lobe is missing forces the gall-bladder to a deep, posterior position. This little sac, in the human being, holds from thirty to forty cubic centimetres of bile, which is darker and thicker than that in the biliary ducts; in fact, it is the residue of

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from 250 to 400 cubic centimetres or more of bile which went into the gall-bladder. The bile in the gall-bladder is from eight to twelve times more concentrated than that which has just been made by the liver and is found in the hepatic ducts. This concentration is apparently wholly due to filtration of the fluids of the bile which pass through the wall of the gall-bladder into the venous circulation or the lymphatic channels. Herein is seen the benefit of the large arterial supply to the gall-bladder, the mucous membrane of which, secreting colloid mucus, maintains the solvency of bile salts and pigment; therefore anything which would add to the function of filtration of the gall-bladder or which would reduce its blood supply would contribute to failure of maintenance of solvency, and sediment would appear. If the end of the common bile-duct is blocked, the gall-bladder and ducts are soon distended with granular, thick bile, and deep jaundice appears. In a few weeks, however, when the liver can force no more bile into the ducts, this mucus redissolves the biliary sediment, and the so-called white bile appears in the gall-bladder and ducts. Inasmuch as the gall-bladder cannot get any bile without closure of the papilla of the common bile-duct, which forces the bile backward through the cystic duct, conditions in the intestine might arise which would add to spasm of the sphincter of Oddi and would increase the work of filtration in the gall-bladder. The common bile-duct has low tension at its outlet in most of the types of life in which the gall-bladder is absent. However, in some the tension rises at times to seventy milligrams and it fluctuates to a far greater degree if a gall-bladder is present. Through stimulation of the liver, bile should flow on the taking of food, and as long as there is food in the stomach or duodenum. After food has passed the duodenum, there is great lessening of hepatic function, and until the next meal, most of the bile should be handled by the gall-bladder. In those who have excessive spasm of the sphincter of Oddi there is usually fluctuation in color of the bowel movements from light to dark. The periods are usually of two or more weeks' duration. Rarely, in my experience, has this spasm been sufficient to produce mild jaundice, as reported in German literature, yet it may account for variations in the percentage of bile in the blood.

It was formerly believed that the gall-bladder caused disease of the liver, and it is probably true that the severity of hepatic disease is often increased in the advanced stages of mechanical obstruction involving the common bile-duct. We now believe it is more probable that, through hepatic tension, the liver becomes harder and darker, and that the thin, sharp edges become rounded. Often there is evidence of excessive filtration on the surface of the liver about the gall-bladder, and deposits of connective tissue. At times, local hepatitis on the surface, resulting from the prolonged over-filtration, causes adhesions to the bowel, the omentum or the parietal peritoneum. Thus, it seems that the liver is the primary sufferer in the beginning of the diseases which are finally evidenced in the gall-bladder.

Many types of life in which the gall-bladder is present are found to be subject to gall-stones. In the human being gall-stones were noted to be com-

mon, and, a few decades ago, when safer surgery became possible, exploration and various procedures were developed to deal with disease of the gall-bladder. Little attention was paid to the condition of the liver or the biliary ducts. For a number of years, in spite of adhesions and evident changes in the gall-bladder, the tangible evidence of gall-stone was the essential indication for opening the gall-bladder, and it was drained and preserved as a necessary organ unless it was so seriously diseased that it was impossible to preserve it. When it was preserved, many patients were not quite well, and some had a recurrence of gall-stones.

In considering the diseases of the gall-bladder itself, cholecystitis comes under consideration. Often this condition is shown by thickening of the walls of the viscus, with adhesions to other structures which evidently come from inflammation in the gall-bladder. This may have become chronic, and there may be changes in the mucous membrane, commonly called strawberry gall-bladder. The characteristic small spots often show through the wall of the gall-bladder or, with bacterial irritation of local areas, papillomatous growths in the mucous membrane may be caused. Small stones are not always felt by palpation of the gall-bladder with thickened walls that is under some tension. The infected gall-bladder may empty its toxic bile into the intestine from time to time, and this structure is probably the carrier of *Eberthella typhi*. Rosenow showed that the gall-bladders of typhoid carriers and of those infected by *Escherichia coli* or streptococci again take up their function after subsidence of the acute or subacute attacks of inflammation. The organisms are then found by culturing the submucous tissue. If general evidence of marked chronic hepatitis such as I have described is present, the biliary tension can certainly be lowered by removal of the gall-bladder together with half of the cystic duct. This apparently reduces the tension to that found in animals which do not have gall-bladders. Although the hepatic and common ducts may be distended, they become distended but little more, if any, when the gall-bladder is lost. Probably half of the persons who reach the age of fifty years have considerable evidence of chronic hepatitis; it is said that in every hundred of these, twenty have marked evidence of cholecystitis and twelve of the twenty have gall-stones.

Among the multitudinous functions of the liver, separation of the heavier metals is one. After it is prepared by animal cells, the iron is found ready for the use of the living cells, and the juices of the liver are now prolonging the lives of countless sufferers from pernicious anæmia. Rowntree pointed out years ago, when testing the function of the kidney and the liver, that the chlorides were not handled by the kidneys but by the liver. This division of chemical function led to modern clinical investigation of conditions and functions of the gall-bladder, by means of dyes that are impervious to Röntgen rays being given by mouth or intravenously. Mann, in his experimental work on the possible dangers of an excess of Carrel-Dakin solution (sodium hypochlorite) in closed cavities, showed that intravenous injection into animals of five to ten cubic centimetres for each kilogram of body weight of this

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solution exerted its destructive effects on the gall-bladder and produced round-cell infiltration with inflammation which, microscopically, resembled that due to bacteria. Injection of twelve cubic centimetres of this material for each kilogram of body weight usually caused death of the animal.

The liver has the greatest power of regeneration of any structure in the body; apparently its cells are constantly changing, being destroyed and renewed. Combinations of carbon with the chlorides produce extensive destruction of the hepatic cells and, if their administration to animals is long-continued, changes resembling chronic cirrhosis are caused. Through experimental research and clinical observation it has been proved that surgery for disease of the liver, although directed against an extensively diseased gall-bladder, is a dangerous procedure. The practical observation is that when a hardened, granular or cirrhotic liver is present, one of its major functions must be thought of; namely, the handling of sugar. If it is felt that sugar cannot be mobilized, the patient should be given a solution of glucose intravenously several times in the first four days following operation. When cirrhosis is produced in animals, life is maintained very comfortably with a limited amount of hepatic substance, so long as plenty of carbohydrate, in the form of syrup, is given daily. When meat is fed to them, ascites develops and they quickly die from toxemia, the result of reduced hepatic function.

The condition of the head of the pancreas should be noted in cases of hepatic disease, for the pancreas is directly connected with the liver in function and it empties its secretion through the same outlet as the liver. A diseased liver may cause secondary changes in the pancreas. The head of the pancreas partly encloses the lower part of the common bile-duct, and, through pancreatic disease, sometimes causes obstruction of the common bile-duct. If the head of the pancreas is large, irregular, and hard, interstitial pancreatitis may be present. If the head of the pancreas is smooth, hard, and large, the disease is of the interacinar type, which may be associated with acute pancreatitis, hæmorrhage, high temperature, fat-necrosis and ascites with blood-tinged fluid. Less serious conditions are frequently found in the pancreas. A diseased pancreas may cause colic referable to the biliary ducts after the gall-bladder has been removed. A more serious condition that may be present is carcinoma.

I would urge that, at exploration, the liver be more carefully inspected, and that the size of the glands on the ducts be examined to see if removal of the gall-bladder is not warranted in many of these cases in which there is need of relief of hepatic tension. In these cases, there may not be much to be found in the gall-bladder, by palpation, but there may be evident disease when it is examined after removal. The disease of the liver is primary, and the gall-bladder is secondary in importance in the bodily economy. Nevertheless, it may be wise to preserve, and drain, the gall-bladder in cases of acute illness.

ACUTE CHOLECYSTITIS

BY RICHARD H. MILLER, M.D.

OF BOSTON, MASS.

THIS discussion represents the results of a brief inquiry into the treatment of acute cholecystitis—an inquiry directed particularly at the question of how long one should wait before performing operation in the case of the acutely inflamed and infected gall-bladder. The study was stimulated by the observation of two cases which perforated, with serious results, while attempt was being made to improve the patients' general condition, and a subsidence of the acute condition was confidently expected.

In the first place, it is necessary to record exactly what is meant, in this paper, by acute cholecystitis. I refer to those cases with all the symptoms and signs of acute inflammation—pain, elevated temperature, pulse and white blood count, and tenderness and spasm over the gall-bladder. The gall-bladder itself is swollen, œdematous, distended; the cystic duct is occluded, almost always by a stone; and the contents consist of one or more stones, bile and mucus, and perhaps pus. These cases present a perfectly definite picture of acute infection, just as does the acute appendix, and the two conditions are analogous. One reads in the literature references to acute cholecystitis without stones; certainly this does occur, but, in my experience, by far the greater number do have stones present, and operation reveals either a stone in the cystic duct, or evidence that one has been displaced from the cystic duct during operative manipulation.

Wilensky¹ mentions acute and chronic empyemata of the gall-bladder without stones, resulting in attacks resembling acute appendicitis; Mitchell,² in reporting sixteen cases of perforation, says that "stones are not so often found as in the more chronic cases." W. J. Mayo³ speaks of cases of chronic cholecystitis, either without stones, or with stones so small that they cannot be felt through the wall of the gall-bladder, which become acute and cause blocking of the cystic duct from swelling and œdema. In another study, Judd and Mentzer⁴ report 1,000 cases of cholesterosis, of which one-half showed no stones; and one quarter of the cases without stones had, at one time or another, pain severe enough to require morphine; these cases were therefore acute, but I do not believe the acute picture is the same as that in the serious inflammation, to which I here refer.

I believe that most of the gall-bladder cases which the surgeon sees, which come into the Emergency Ward of the urban hospitals with an acute abdomen, are due to a stone in the cystic duct, and must be considered as potentially dangerous because of the tendency either to rupture into the free abdominal cavity, or to walled-off perforation, with an abscess in the liver or alongside of the gall-bladder. Alexander⁵ has recently reported twenty cases, of ruptured gall-bladder—eight into the general abdominal cavity, and twelve walled-

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off. I present later 200 cases from the Massachusetts General Hospital, of which a number show no record of stones; in fifty unselected private cases, forty-nine had stones, and the only one which did not was an acute cholecystitis associated with a subacute pancreatitis. The occurrence of an acute surgical cholecystitis without stones is, in my experience, extremely rare.

With a stone impacted in the cystic duct nothing flows in or out of the gall-bladder, but the mucous membrane continues to secrete mucus as long as it can, against the intracystic pressure. Hydrops first occurs, and then there may supervene empyema. If the gall-bladder has not been thickened by previous inflammation it distends rapidly, the circulation of its wall may become interfered with, and gangrene—the fore-runner of perforation—may result. If the gall-bladder has become thickened, it will not distend rapidly, but the subsequent intracystic infection may penetrate the wall and result in a contiguous abscess. Halpert⁷ states that under stress the muscular layer of the gall-bladder not only hypertrophies, but herniæ of the mucosa through pouches in the muscular wall can be seen—a condition which would seem to predispose to perforation. The rapid distension of a thin gall-bladder causes excruciating pain, not easily controlled by morphine. The slow distension of the thick gall-bladder causes much less pain, and it can usually be controlled without difficulty. It must not be forgotten that a pancreatitis, of greater or less degree of severity, may supervene; according to Colp,⁸ gall-bladder disease precedes pancreatitis in 85 per cent., but in 1280 cases of gall-bladder disease pancreatitis occurred in only 2.6 per cent.

Our teaching has been to allow these cases time to subside, so that operation may be performed when acute infection is not present. This has two advantages: first, the patient will stand the operation better; and, second, the chances of being able to do a cholecystectomy, rather than cholecystostomy, will be greater. Following out this idea, I watched one case in a comparatively young woman who had very severe pain, and the gall-bladder perforated while we were preparing for operation, and the patient eventually died. A second case perforated the gall-bladder under similar conditions, and at operation there were found not only a bile peritonitis but profuse hæmorrhage from a small artery in the gall-bladder wall; this patient recovered. The next case in point was one in which immediate operation was performed and a hugely distended gall-bladder, greenish-black at the fundus, and about to perforate, was found and drained, with recovery. These cases are, of course, exceptional, but they instigated this investigation. They satisfied me that a confident policy of "laissez-faire" was distinctly dangerous, and led me to question the general policy of postponing operation in these cases.

Furthermore, W. J. Mayo⁹ says that a foul infection of the gall-bladder, associated with perforation, may occur simultaneously with an acute perforative appendicitis. He says that in case of the former, one should look at the appendix to determine its state. I have never seen this combination of circumstances, and it would not have occurred to me to investigate the appendix in the operation for a truly septic or perforated gall-bladder, for

fear of spreading the infection, but if the two conditions tend to occur together, it would certainly be an additional argument against delay in operation in the seriously acute gall-bladder.

If a truly acute gall-bladder is treated conservatively, one of three things may happen: (1) subsidence of the infection without destruction of the wall of the gall-bladder; (2) perforation with local abscess; and (3) perforation with general peritonitis. I question whether our ability to predict what may be the outcome is dependable enough to warrant our waiting, on the theory that the first of these events, retrogression of the process, will take place.

I have selected for study 200 cases, operated on for acute cholecystitis, from the records of the Massachusetts General Hospital. They were picked out in chronological order, being the last 200 in the card catalogue, and they were not chosen for any especial characteristics they might show. Of these 200 cases 160 gave a positive statement that stones were present. In forty, or 20 per cent., no note was made of stones. I believe this figure to be inaccurate, and that there were not even as many as forty without stones; probably in at least a few of these cases the operator neglected to note their presence when he dictated the account of the operation.

In these cases there were seventy-four, or 37 per cent., in which there were no adhesions about the gall-bladder, and nineteen, or 9.5 per cent., in which the note about adhesions was doubtful of interpretation. The fact that between one-quarter and one-half of the total number were not walled off is a fact which demonstrates the possible danger of spreading infection in the event of perforation.

Twenty-seven cases, or 13.5 per cent., died, their average age being 52.8 years. In these fatal cases the average duration from onset to operation was 15.0 days, and in the other 173 who recovered, the average time from onset to operation was 8.3 days. I went over the figures carefully, because it was, in few instances, difficult to be sure of these lapses of time; I believe them to be, on the whole, accurate. The length of time seems long, and in many instances this was due to the fact that the patients were sick at home many days before they came to the hospital. In any event, they show a striking difference between the two groups, the fatal cases having been given palliative treatment a whole week longer, on the average, than those which got well.

Of the fatal cases eight, or 30.7 per cent., had local perforation, none had general peritonitis, and four were doubtful. Furthermore, six, or 22.2 per cent., had no adhesions, seventeen did have adhesions, and in four there was no note.

The operation consisted, in the twenty-seven fatal cases, of cholecystectomy in fourteen and drainage in thirteen—practically equal numbers. In the 173 who recovered, complete removal was done in three-quarters—130, or 75 per cent. These figures prove nothing—one might interpret them to

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favor removal instead of drainage, which would, of course, be a false conclusion.

I look on the above findings, though they are not striking, as furnishing support for the contention that inconsiderate procrastination in these cases may be poor judgment.

The general dictum that a septic process, anywhere in the body, should be drained, without undue delay, seems to me to hold true in infection of the gall-bladder. There are certain objections against precipitate operation: first, the patient's condition may be poor, and require amelioration; second, an operation performed in a very acute stage may necessitate simple drainage rather than the preferable cholecystectomy. In regard to the first, I would say that, without question, proper medical care should at once be instituted, and pre-operative measures should be undertaken, such as care of the heart, administration of fluids and similar procedures. In a desperately sick case, operation may be contraindicated, just as it may be in certain cases of extreme peritonitis due to a perforated appendix. In regard to the second, the possibility of the operation having to be limited to drainage, I believe that the doing of the operation in two stages may be preferable to waiting with the hope of doing it all in one; if the gall-bladder is not too badly diseased, and all stones are removed, a second operation may not be necessary; and if a second operation is necessary, the fact the previous operation has been performed does not make it much more difficult. The operation in the acute stage is best performed with some other anæsthesia than ether; spinal anæsthesia is successful in many cases; a very satisfactory method is the use of local anæsthesia supplemented, when necessary, by nitrous oxide; in this instance the pre-operative use of morphine and scopolamine is of great value. An attempt should always be made to determine whether there is a stone in the cystic duct, and, if there is, to dislodge it. I would say that a delay of twelve hours, for the administration of fluids, and other pre-operative measures, should, where possible, be allowed; but not in the presence of very acute symptoms.

My experience, and the scrutiny of the above cases, lead me to the conclusion that, when confronted with the the acutely infected gall-bladder, the surgeon's attitude should not be, "How long shall I postpone this operation?" but "Why should I not operate now?" In the presence of definite subsidence of symptoms and signs of which the surgeon is sure, and with the patient's condition good, operation may be safely put off. If, on the other hand, there is a persistence of temperature, tenderness and spasm; and, particularly, and most important, if there is severe pain, not easily controlled, surgical intervention should be undertaken without delay. In cases in which the patient's condition is questionable, the surgeon should not allow himself to be tempted into complete removal of the gall-bladder. In these instances simple drainage is not an operation to be deprecated; it may be the very best thing, and may represent the first stage in a life-saving pro-

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cedure, comparable to preliminary cystostomy in the acutely obstructing prostate.

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EXTERNAL AND INTERNAL BILIARY FISTULÆ FOLLOWING CHOLECYSTECTOMY

BY FRANK H. LAHEY, M.D.

OF BOSTON, MASS.

IN 1923,* we published our experiences with our first two transplantations of complete external biliary fistulæ. We have now done the operation upon ten patients, with the following results. Six are well and free from

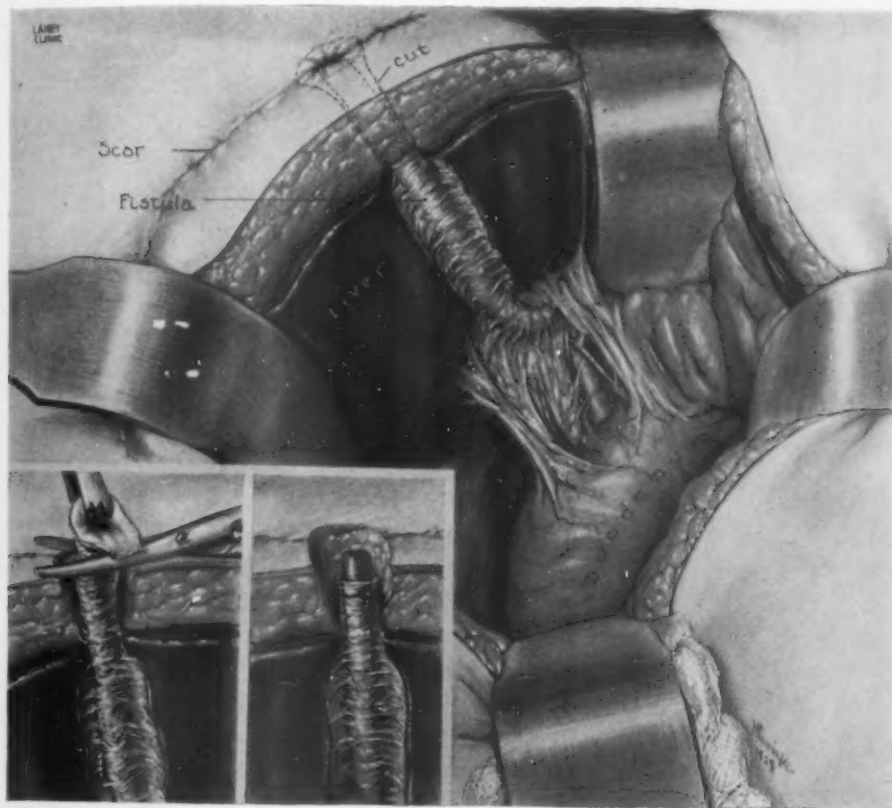


FIG. 1.—Showing diagrammatically the fistulous tract running along the bed of the liver and in dotted lines the plan of coring it out of the abdominal wall. Inserts showing the fistulous tract cored out of the abdominal wall and in one the button of skin being cut away; in the other, the small section of rubber tubing tied into the end of the fistulous canal.

symptoms. One has been a complete failure in that the complete external biliary fistula has returned. She will have another attempt at transplantation in three months more. One is a partial failure in that she is suffering from intermittent frequent attacks of biliary obstruction or infection so

* Implantation of Biliary Fistula into Duodenum, *Journal of the American Medical Association*, March 31, 1923.

that she does not enjoy life, and will probably require reestablishment of the external biliary fistula. Two died following the operation.

We have published the operative plan as we have employed it, and have laid down a few rules which we have learned as the result of our experiences with these cases which may be helpful to others. The most important of these is, we believe, that the fistulous tract may be cored out of the abdominal

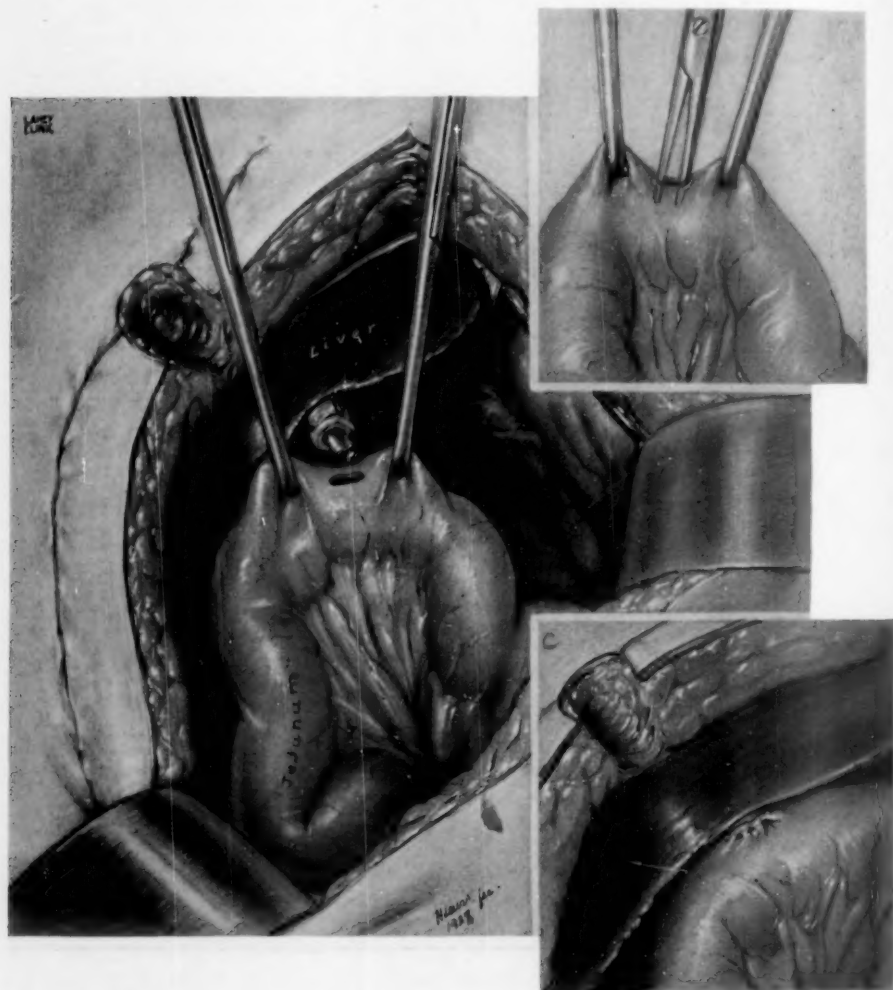


FIG. 2.—The anterior surface of the liver freed from the parietal peritoneum and turned down to meet the jejunum (or pre-pyloric gastric region) pulled up, with the opening in the intestinal canal into which the sinus is to be transplanted. One insert shows a method of making an opening when jejunum is used, the other insert showing fistula transplanted and bowel pulled well up against the liver edge so that there is no free fistula.

wall, but should not be dissected free from the under surface of the liver, from which it doubtless receives a good deal of its nourishment, which in turn helps to prevent contraction. (Fig. 1.) It therefore becomes necessary to mobilize the stomach, duodenum or jejunum so that it can be brought up to the anterior surface of the liver, the entire fistulous tract pushed into

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the intestinal canal, the wall of which is sutured about it snugly by a purse-string suture, and the stomach or bowel—whichever is used—sutured to the capsule of the liver. All of the fistulous tract which is cored out of the abdominal wall is pushed through the lumen of the stomach or bowel, so that there is no free, unnourished fistulous wall between the liver edge and the intestinal wall. (Fig. 2.)

We have learned also that the production of complete external biliary fistulæ is by no means a simple procedure, and in dealing with the ten cases

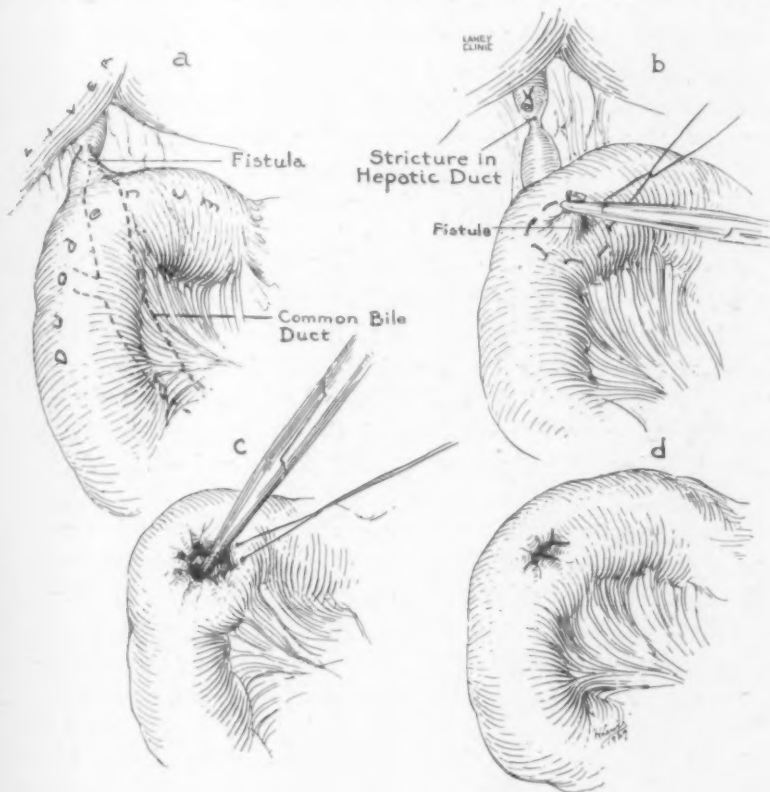


FIG. 3.—Diagrammatic illustrations of a spontaneous internal biliary fistula between the hepatic duct above a stricture and the duodenum. a, Showing fistula unseparated. b, After separation of the fistula and a purse-string suture in the duodenum for inversion. c and d, Closure of the fistula and the duodenum.

in which we have attempted to produce complete external biliary fistulæ, we have encountered and demonstrated at operation four cases in which spontaneous internal biliary fistulæ had occurred, the duodenum or stomach attaching itself to the hepatic duct above a stricture and a small and inadequate spontaneous fistulous canal being established between the two. In all of these four cases, the spontaneous fistulous canal was not of sufficient size to prevent back pressure and jaundice, and in each case it was necessary to detach these spontaneous fistulæ and to establish complete external biliary fistulæ. (Fig. 3.)

In our experience in establishing these complete external biliary fistulæ, we have had some surprising occurrences. In one of our earliest cases in which the common and hepatic ducts had been completely excised at a previous operation elsewhere, a very satisfactory preliminary external biliary fistula was established by suturing a large catheter into the hepatic duct where several months before it had been cut across just at the point where the hepatic divided into right and left branches. Bile drained well through the tube for two weeks, at which time the tube came out. For a few days there was good external biliary drainage through the external biliary fistula without the tube, when suddenly all external biliary drainage ceased, the stools became colored with bile, and the patient was not jaundiced. We were considerably disturbed by this first occurrence of this event in our experience, and presumed that either we were wrong in our observation that the entire hepatic duct had been excised, or a spontaneous internal fistula had been established. Within a few weeks bile ceased entering the intestinal canal, the patient returned to the hospital deeply jaundiced, and was reoperated upon. Again a complete obstruction was found in the hepatic duct, and again a tube was sutured into the hepatic duct and an external biliary fistula established. Again, after the removal of the tube, the external flow of bile ceased, the stools became colored, and quite evidently another spontaneous internal biliary fistula had been established. Again at the end of a few weeks bile ceased entering the intestinal canal, the patient was deeply jaundiced, developed bleeding from wound granulations, and later died without further operation.

We have in contradistinction to this experience two other much more satisfactory patients—one who came to us with a post-operative, very narrow stricture of the hepatic duct due to that structure having been clamped at the previous cholecystectomy (done elsewhere), in whom a complete stricture followed a plastic repair of the strictured duct, and in whom we later produced a complete external biliary fistula. The other patient came to us with complete loss of her hepatic duct following a cholecystectomy done elsewhere. In both of these cases, following the production of complete external biliary fistulæ by suturing a tube into the hepatic duct, soon after the removal of the tubes completely satisfactory spontaneous internal biliary fistulæ developed, as was evidenced by the sudden stopping of all external biliary discharge and the stools becoming well colored. Both cases are in very satisfactory condition—one at the end of three months and the other at the end of twelve months. No jaundice has appeared in either case, the stools have remained well colored, and both patients are in excellent health.

It is evident, then, that while some spontaneous internal biliary fistulæ may be so situated and possibly of such calibre that they will function satisfactorily and not contract, other less satisfactory spontaneous internal fistulæ will occur, will function as internal fistulæ long enough to permit the external fistula to heal, and later contract and close, necessitating reoperation and, as in one of our first cases, again exposing the patient to the

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same danger of closure following the production of a second external biliary fistula.

As we suggested in the publication seven years ago of our description of our first two experiences with this condition, we presume that complete external biliary fistulæ remain open from the fact that the secretory pressure of bile is in all probability greater than the ability of the vascularized scar tissue in the sinus tract to contract. The balance of control in this situation must, however, be within quite narrow limits, and when in complete external biliary fistulæ even a very small spontaneous internal biliary fistula is established between the duct and the duodenum, pressure within the fistulous tract distal to the spontaneous fistula becomes lowered and the ability of scar tissue in the external sinus tract then controls the situation and contraction and closure of the sinus results.

The explanation as to why some spontaneous internal fistulæ remain open satisfactorily and why some close spontaneously, and as to why complete external biliary fistulæ do not close can be approached only upon a problematical basis.

It seems at least probable that external biliary fistulæ, as we first suggested in our original article, may well retain a greater ability to resist contraction when well vascularized, as when the sinus is completely in contact with the under surface of the liver throughout its entire extent, where certainly an excellent and profuse blood supply is at hand to supply vascularization. This same feature may possibly supply the controlling factor in spontaneous internal biliary fistulæ when the duodenum or stomach attaches itself directly to the under surface of the liver over the sinus, and spontaneous anastomosis then occurs between the duodenum and the vascularized sinus in the liver bed, producing a direct fistula which will not contract as has been the case in the spontaneous internal fistulæ spoken of above. When, however, the fistulous tract burrows for any distance to reach the duodenum and a free sinus of any length unvascularized by attachment to the liver bed is established, contraction as the result of bile irritation, infection, and lack of blood supply probably then occurs.

From our experience with the production of complete external biliary fistulæ, we have learned then that spontaneous internal biliary fistulæ are at times the cause of failure of external biliary fistulæ to remain open until such time as they are ready for transplantation, and that if we wish to protect the patient against the possibility of his external biliary fistula being either completely destroyed or made ineffectual by the spontaneous establishment of a communication between the fistulous tract and the duodenum, measures must be taken to lessen the likelihood of such a calamity.

Because of our experiences with a patient who has developed inadequate spontaneous internal fistulæ, thus spoiling the external fistulæ before they could be transplanted, we have attempted to prevent this undesirable event by turning up the omentum over the duodenum and suturing its right free border to the posterior parietal peritoneum just proximal to where that

structure passes over unto the first portion of the duodenum and over the pylorus and pre-pyloric region. (Fig. 4.) We have done this now in but two cases, but we hope that the interposing of this structure between the fistulous canal and the duodenum will at least lessen the chances of the occurrence of a spontaneous internal biliary fistula and destruction or impairing of the complete external biliary fistula.

We have now operated upon one of the cases in which omentum was interposed as described above between the fistulous tract and the duodenum and stomach, and it in no way interferes with the ease with which the transplantation of the external biliary fistula can be done. Based upon our

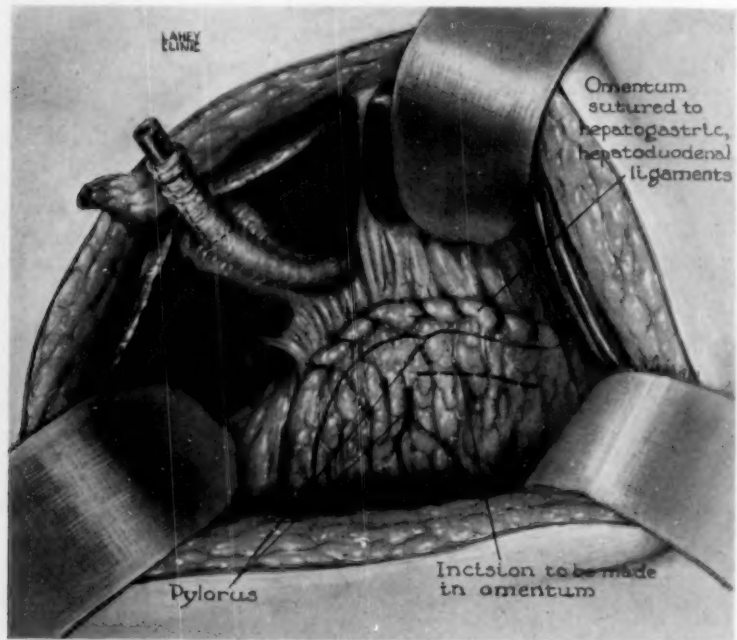


FIG. 4.—The method of suturing omentum over the duodenum, pylorus and pre-pyloric portion of the stomach to the parietal peritoneum to prevent destruction of the external biliary fistula by the production of a spontaneous internal biliary fistula between the fistula in the bed of the liver and the duodenum or stomach. The pylorus is shown in outline beneath the omentum placed over it. The dotted line on the interposed omentum shows the incision to be made in the omentum through which stomach will be pulled for implantation of the fistula.

experience with only this single case, it seems possible that it may prove of value, since it makes one able to conduct the transplantation of the cored-out fistula almost extraperitoneally.

In this case, after the abdomen had been opened and the fistulous tract prepared for transplantation by coring it from the abdominal wall, an opening in the interposed omentum was made over the portion of the stomach close to the pylorus and a sufficient amount of stomach to reach readily up to the edge of the liver at the base of the free portion of the fistulous tract pulled out with Allis forceps. The edges of the rent made in the omentum were then sutured to the base of the apex of stomach pulled

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through the rent in the omentum, thus making the portion of the stomach into which the fistula was to be transplanted largely extraperitoneal. (Fig. 5.)

The stomach we believe should be employed when possible: (1) because we know from our experience with one of those cases now well seven years after transplantation of a fistula into the stomach, and from everyone's experiences with cholecystgastrostomy in carcinoma of the head of the pancreas, that the stomach tolerates the introduction of all bile into it satisfactorily; and (2) because, should leakage occur following the transplantation of the fistula, it will be of much less serious consequence if it be a gastric fistula rather than a duodenal one.

With the pre-pyloric portion of the stomach pulled out through the opening in the omentum and that structure sutured to the stomach to make

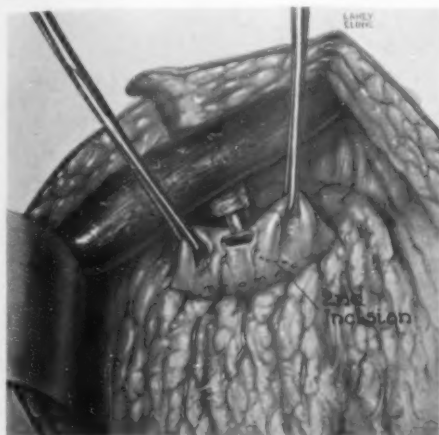


FIG. 5.—An incision has been made in the omentum and the liver has been turned down from the parietal peritoneum and an opening has been made into the stomach. The fistulous tract with a rubber tube in it is ready for implantation and the dotted line shows the point of second incision in the stomach which will expose the implanted stricture within the stomach as shown in Fig. 6.

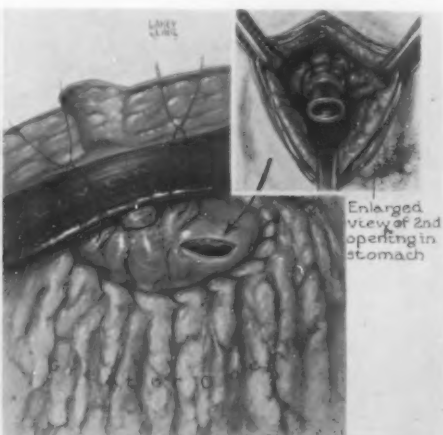


FIG. 6.—The fistula has been pulled into the opening in the stomach. The purse-string suture about the fistula is not shown but two lateral sutures approximating the stomach to the liver are shown. The counter incision is shown in the stomach and in the insert. This incision is held open to show the fistulous tract pushed into the stomach and how it may be sutured to the mucosa within the stomach.

it extraperitoneal, a small opening is made at the apex of the pulled-out stomach at the point which will readily reach the anterior surface of the liver at the base of the fistula, a suction tube passed into the held-up opening, and any excess of gastric contents sucked out. Two stitches are passed through the capsule (and scar tissue) on the under surface of the liver, one on either side of the fistulous canal and just beneath the shelving edge of the liver. These are then passed through the stomach wall superior and to either side of the opening in the stomach, as will be seen by Fig. 6, will be the sutures which are to approximate stomach behind the implanted fistula when the stomach is brought up to the edge of the liver. It is necessary to insert these stitches before the sinus tract is implanted into the opening in the stomach, as it is not possible to get them in after the sinus has been inserted into the gastric opening.

DISCUSSION

One should have in mind our suggestion in the original article, that a short section of rubber catheter of the proper length to fill the free part of the fistula dissected from the abdominal wall and not attached to the liver should be placed in the end of the sinus, extending up that tract just a short distance beyond the free edge of the liver. The rubber tube should be inserted so that the purse-string suture in the stomach about its point of implantation may be tied tightly to prevent leakage without danger of obstructing the sinus. It should extend just beyond the free edge of the liver so that its upper free end on angulation may not cause pressure and perforation of the free portion of the sinus unattached to the liver.

The plan of pulling the fistulous tract well into the lumen of the stomach by means of a counter incision in the stomach and the fixation of the fistulous tract by sutures within the stomach is shown in Fig. 6.

CONCLUSIONS

The surgical demonstration of inadequate spontaneous internal biliary fistulæ between the hepatic duct and duodenum or stomach above strictures of the hepatic duct after cholecystectomy is reported.

The spontaneous closure and entrance of bile into the intestinal tract from complete external biliary fistulæ by undemonstrated but presumably certain spontaneous internal biliary fistulæ is reported, as is the satisfactory progress of these cases over a period of three and twelve months respectively.

The possibility of destruction of the preliminary complete external biliary fistulæ by the occurrence of inadequate spontaneous internal biliary fistulæ, together with a report of such an occurrence twice in the same individual, is reported and a plan to prevent it is proposed.

DISCUSSION: DOCTOR GATEWOOD, of Chicago, said that he had seen a number of cases in which the gall-bladder had been removed and subsequent obstruction due either to stricture or to complete cutting of the duct occurred. In the first cases he attempted by the method suggested by W. J. Mayo to bring the stomach, or the intestine, to the stump of the common or the hepatic duct. It is an operation which is time-consuming and which is difficult in patients who already have a considerable handicap. After he saw Doctor Lahey's first communication he wondered why the fistulous tract had not been used before, and since then he had used it in three instances. In each of these he had been able to use the stomach. He prefers the stomach if at all possible, first, because the gastric fistula is preferable to the duodenal in case they have a leak, and second, because the stomach seems to have less bacterial flora, and, at least from an experimental standpoint, secondary infection of the liver is not so likely to follow. In all three of these cases he had had, at least temporarily, a good result. One of these patients he reported about two years ago as being perfectly well for a year and a half. Since then she has had attacks of jaundice, and while relatively well, evidently has some intermittent obstruction. The other two patients are still well, but he was somewhat dubious as to whether these fistulous tracts will subse-

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quently contract in spite of the fact that they are wide open. He could introduce his little finger into one tract at the time of the operation. He would like very much to know what Doctor Lahey's ultimate results had been in cases of this type.

DOCTOR FRANK H. LAHEY, of Boston, replied these are almost hopeless cases. The surgeon is faced with the situation that there is nothing else but this to do. At least, he knew of nothing else to do. They are not the cases in which one can do duct anastomoses and one approaches these with his mind at ease as far as end-results go. They are doomed to exist as well as they can with complete external biliary fistulæ or to take the best results they can get with transplantations. They are very likely to have more or less infection within the sinus, and certainly in the beginning to have repeated attacks of jaundice.

As to the stomach, he was certain that it is more desirable to make the transplantation into the stomach rather than the duodenum, because a gastric fistula is much less dangerous than a duodenal or jejunal fistula, and furthermore, these cases will require, he believed, more than one operation frequently. There will be failures occasionally but even though they fail, one can again excise the fistula and implant it again.

As to end-results, two cases now, one is alive eight years and another alive seven years. They have had attacks of jaundice. One has had jaundice, off and on, for several years. The other one has had no jaundice and that was a gastric implantation.

One should not be alarmed if occasionally they leak during their period of recovery. He thought that they sometimes leak because the attachment of the sinus tract to the liver may pull off because of vomiting or from moving about, but even with this leakage some of these have closed and remain dry.

BENIGN PAPILLOMA OF THE COMMON BILE-DUCT

By ALFRED T. BAZIN, M.D.

OF MONTREAL, CANADA

A MALE, aged seventy, occupation farmer, was admitted to the Montreal General Hospital with complaints of abdominal pain, dyspepsia and jaundice. For ten to twelve years he had suffered from attacks of severe colicky pain, latterly more frequent, and accompanied or followed by jaundice of temporary duration. The attacks have lasted three to four days and in the intervals

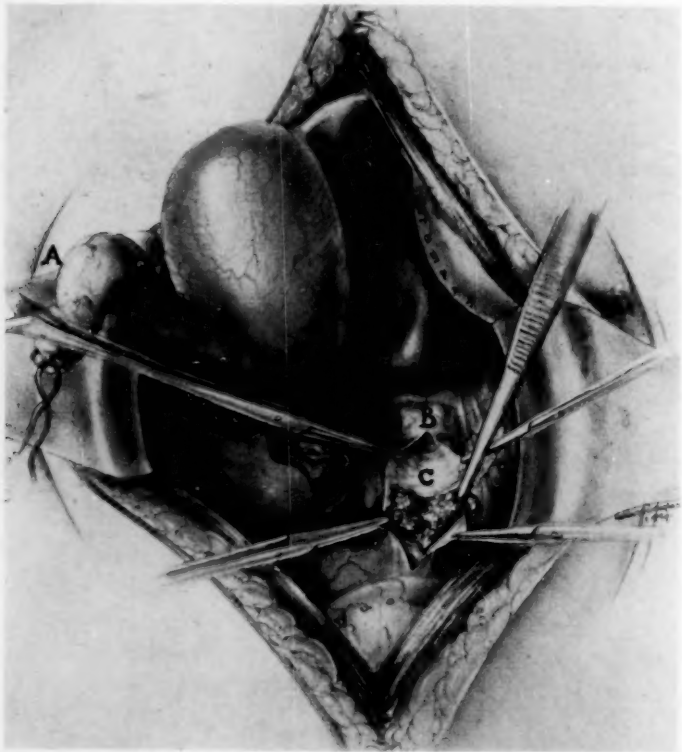


FIG. 1.—Photograph of drawing made at operation. The cystic duct A has been cut across and pulled back. Note the papilloma C in the common bile duct and the dilatation of the duct B above it. The slender pedicle of the papilloma is seen to the left side.

there have been slight dyspepsia and a tendency to constipation. An observation made by his family physician was that the attacks of colic were neither as sharp nor severe as those caused by gall-stones. His medical history is otherwise free from any illness but chicken-pox and influenza.

He presented a well-developed and remarkably preserved physique. The sclera were icteroid, chest clear, slight cardiac hypertrophy and blood-pressure 182 systolic, 90 diastolic. The examination of abdomen revealed tenderness along the right costal margin. Murphy's sign positive, Robson's point negative, liver edge palpable and slightly tender. There was bilateral crypt-

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orchidism, the right testicle being in the inguinal canal, the left on the pubic ramus. There was no evidence of hernia. Urinalysis normal. Blood urea nitrogen seventeen milligrams per 100 cubic centimetres, creatinine 1.45. Fasting blood sugar .105 per cent., blood sugar time curve revealed a diminished tolerance but no delay in assimilation. Radiogram of gall-bladder after intravenous administration of iodeikon showed complete absence of all gall-bladder shadow, but no calculi.

Diagnosis.—Cholelithiasis, cholecystitis—stone in the common duct. Operation, April 10, 1929. The gall-bladder was moderately distended but the wall was free from adhesions and presented little if any alteration from normal. The cystic duct was moderately dilated but the common duct was distended to over two centimetres in diameter. The foramen of Winslow was patent and careful palpation failed to reveal any foreign body in the common duct or in the ampulla of Vater. The pancreas was normal in consistence. The junction of cystic and common ducts having been isolated,

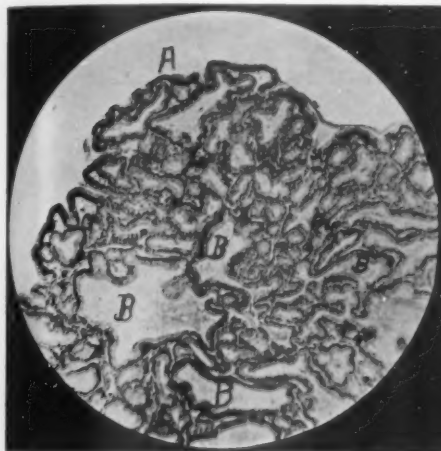


FIG. 2.—Photomicrograph of papilloma showing epithelial lined surface of tumor A and cross sections of gland B B B B.

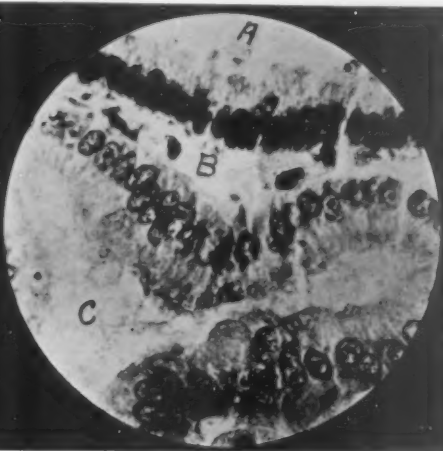


FIG. 3.—Photomicrograph (oil immersion) showing character of epithelial cells lining surface of the tumor "A," interglandular tissue "B" and lumen of gland "C" lined with epithelium. The epithelial cells are cylindrical and regular and have basally-placed nuclei.

the cystic duct was divided, followed by a rush of pale, almost "white" bile. As this was removed it was noted that fresh blood streaked the bile-stream and was emerging from the lumen of the duct. Swabbing pressure on the dilated duct to remove the obscuring flow of bile was followed by the extrusion of rounded pale bodies having the appearance of the component parts of a white raspberry. This revealed the true diagnosis.

The common duct was split downwards and the "red raspberry" came into view. To uncover the whole of the papilloma it was necessary to divide the peritoneum and displace the duodenum. The fragile, freely bleeding papilloma was attached to the anterior surface of the duct by a narrow pedicle, and because of the distension of the duct it was possible to remove that portion of the duct which served as the attaching base. A second pin-point sessile papilloma was observed on the posterior wall of the duct just distal to the site of the principal tumor. T-tube drainage and repair of duct were instituted. Convalescence was uneventful and recovery at present writing is complete.

Examination of the removed gall-bladder, gross and histologic, showed no

papillomatous change and little if any alteration in the structure of the mucosa. Reference to the illustrations discovers the character of the lesion, gross and histologic.

Isolated benign papilloma of the common duct is apparently rare. Benign papilloma of the gall-bladder is, on the other hand, less rare, and when present is frequently associated with papillomatous changes in the bile-duct. All of these papillomata are potentially malignant but we believe that in this specimen no evidence of malignant change presents. I am indebted to Drs. L. J. Rhea and F. D. Ackman for a search of the literature. The reported



FIG. 4.—Microphotograph of longitudinal section of pedicle of tumor. No infiltrating epithelial cells.

cases are variously described as polyps, adenomas, lipomas, *etc.*, and in some instances were associated with inflammatory changes, but rarely with calculi.

1. SOMMER, RENE (Beitrag zur Klinischen Chirurgie, vol. cxxxviii, p. 357, 1926-1927), deals with papillary tumors of the gall-bladder and bile passages. He reports one case of benign papilloma of the common duct, but, in the main, his contribution is a discussion of malignant papillary growths of the gall-bladder.

He points out that there is no relationship between the size of the papilloma and the degree of its malignancy or extent of the metastases.

2. KONJITZNY (Erg. d Allgem. path. und pathologischen anatomie, Bd. xiv, No. 2, p. 827, 1911), contributes a comprehensive article most of which is devoted to malignant tumors, but a small portion deals rather fully with benign tumors. He states that benign tumors of the extra-hepatic bile passages are extremely rare and such as have been described are, for the most part, in the common duct.

3. Pozzi, G. (Gazetta med. ital. lombard, Nr. 49, 1880), observed a forty-year-old man with obstructive jaundice of eighty-seven days' duration which suddenly cleared followed by passage by bowel of large quantities of thick bile and six hard hazelnut-sized polyps, presumably originating in the common duct.

PAPILLOMA OF COMMON BILE-DUCT

4. JOURDAIN (Bull. de la Soc. Anat. de Paris, vol. xxviii, p. 133, 1853), reports the post-mortem findings of a glandular papilloma of the cystic duct in a woman, forty-eight years old, who *intra-vitam* had shown symptoms of chronic biliary obstruction.
5. KRAUSE (Inaug. Diss., Kiel, 1901), mentions as an incidental finding in a case of carcinoma of the duodenum, two pedunculated mucus polyps protruding from the ampulla of Vater.
6. MONARI, A. (Clin. med. Ital., vol. xxxvii, No. 5, p. 289, 1898), described, in the common duct, three and one-half centimetres above its duodenal orifice, a scarred stricture on which were located polypoid excrescences.
7. ROLLESTON (Lancet, February 16, 1901), described a papilloma of the common duct situated upon the pressure scar of a calculus.
8. KAUFMANN, E. (Lehrbuch der speziellen pathologischen anatomie, vol. v, Aufl., Berlin, 1909), mentions a specimen in the Breslau museum that originated from gall-stones in a horse. The bile passage showed a tightly wedged cylindrical papillomatous growth.
9. CALZAVARA ("Über Adenome des Verdauungskanaals." Virchow's Archiv., Bd. cxli, p. 221), reported a pure adenoma in the orifice of the ampulla of Vater. He also reported a myoadenoma of the common duct. In both instances there was diffuse thickening of the lower segment of the bile-duct and a general inflammatory reaction in the walls of both ducts and gall-bladder.
10. ALBERS (Atlas der pathologischen Anatomie, 4, Tafel, 38, und erläuterungen dazu, 4, 1, Abt. S. 490, Bonn, 1862), refers to a case described by Ehrmann in which a bean-sized fibroma was located in the wall of the ductus choledochus causing obstruction and enormous dilatation of the proximal bile-duct and gall-bladder, with icterus.
11. HOLZINGER ("Über ein Fibrom des Ductus hepaticus." Diss., München, 1901), described an obstructing fibroma of the ductus hepaticus in a seventy-five-year-old woman.
12. VOLMER ("Ein Adenomyofibrom in der Wand des Ductus choledochus." Arch. f. Klin. Chir., Bd. lxxxvi, pp. 160-167, 1908), reported an adenofibroma. It was found as a hazelnut-sized hard tumor in the lower segment of the ductus choledochus of a thirty-eight-year-old woman, and was the cause of a dilatation of the ductus choledochus to the size of the small intestine and the gall-bladder to the size of two fists.
13. BOUISSON ("De la bile, de ses varietes physiologiques, et de ses alterations morbides." Montpellier, p. 137, 1843), reported a submucous polyp.
14. WARDWELL (Lancet, vol. ii, p. 407, September 18, 1869), also reported a submucous polyp. He also referred to a case of a child, three years of age, in which the jaundice had come on suddenly at birth. At the junction of the cystic and common bile-ducts, he found a fatty tumor the size of a large horse bean.
15. COURVOISIER (Kasuistisch statistische Beiträge, sur Pathologie und Chirurgie der Gallenwege, Leipzig, 1890), does not believe, however, that this was a lipoma. He thought this fat formation was due to fatty degeneration. However, he concedes that the tumor could have been a lipoma because such tumors have been found in animals.
16. NEUSSER, E. ("Ein Fall von Icterus catarrhalis mit letalem Ausgang." Stschr. f. klin. Med., vol. vii, p. 32, 1884). A man, aged thirty-nine, with a history characteristic of catarrhal jaundice, developed, during his stay in hospital, severe symptoms of hæmorrhagic diathesis and cerebral disturbance different from those of the benign catarrhal jaundice. Necropsy revealed an enormous dilatation of the common and hepatic ducts which were filled with the same fluid as the smaller intrahepatic ducts. Only the lowest portion of the common duct, about four centimetres in length, was not distended. Its wall was swollen. It was obstructed by a polypoid growth of the mucosa, the size of a small pea, situated in the posterior wall 0.5 centimetres above the ostium. Below it there was a mucous plug. Histologic examination of the polypoid growth revealed a marked proliferation of the mucous glands of the common duct without cell irregularities.

DISCUSSION: DR. EDWARD W. ARCHIBALD, of Montreal, Canada, reported a somewhat similar case to that of Doctor Bazin's. The patient, a woman of about sixty, had been operated on in a small hospital for some gall-bladder condition, the gall-bladder being removed. This was in the spring of last year. She was well through the summer, but in September began to have renewed attacks of nausea and jaundice, though without pain. She had a great number of these attacks during the winter, one every week or ten days. The jaundice lasted usually about two days. She had nausea, but never any pain. He operated and found no stone in the common duct, and only a very moderate dilatation of the common duct. A large probe, passed through the opening of the common duct into the duodenum, apparently met with no obstruction. He opened the duodenum, and then found a tiny papilloma projecting into the lumen of the duodenum, involving only the anterior half of the common duct at its opening, and he excised it. It proved to be a pure benign papilloma. The patient made an uneventful recovery. The point he wanted to make is that one should not be content when one can discover nothing in the common duct under such circumstances, but should proceed without hesitation to open the duodenum, whereupon one may be rewarded by finding something of this nature. Such small tumors cannot be recognized by palpation. Kausch, in his very excellent original article emphasizes this point, that many of these small growths may not be palpable, and that only a duodenal exploration will reveal the true nature of the obstruction.

DR. FREDERIC W. BANCROFT, of New York, said that prior to 1903 he analyzed some sixty cases of acute cholecystitis that had been treated as emergencies and operated upon soon after admission. Either cholecystectomy or cholecystotomy had been performed. In this series the mortality approached 18 per cent. The recent improvements in anæsthesia and post-operative therapy would probably bring down such emergency operation percentages to some place around 15 per cent.

While unquestionably a few cases of cholecystitis do perforate without walling off and do form abscesses, he thought that, in general, cases in which operation has been delayed for several days until the temperature has subsided do much better than when operated upon immediately. He believed one might take a middle ground. If a patient's temperature and leucocyte count does not subside within forty-eight hours, operation should then be performed, as it is obvious that either gangrene is progressing or that there may be a perforation either into the liver or into the neighboring peritoneum, with the formation of a localized abscess. From a study of the cases analyzed in 1903 he was convinced that an immediate cholecystectomy in an acute cholecystitis is in general a dangerous procedure. Moreover, with delay there is a possibility of introduction of fluids or transfusion which will help to build up the resistance of the patient.

RECONSTRUCTION OF THE BILE PASSAGES WITH SPECIAL REFERENCE TO HEPATICO-DUODENOSTOMY

BY LE GRAND GUERRY, M.D.

OF COLUMBIA, S.C.

BEFORE the Surgical Section of the American Medical Association, which met in Chicago, October 12, 1918, I presented a paper on "Reconstruction of the Bile Passages." At this time we said, in part, that surgeons are occasionally forced to the necessity of reconstructing the common duct.

Surgical literature is full of case reports, and many methods have been advocated by equally as many authors—transplanting of fascia; transplanting of blood-vessels; transplanting of the peritoneal layer of the duodenum; and so on to the end of the chapter.

Experimentally, many plans have been tried on dogs with varying degrees of success. Unfortunately, however, methods that will work with apparent satisfaction in the experimental laboratory will not always be successful when applied to the human abdomen.

My personal conviction has always been that whenever direct anastomosis could be established between the bile passages and duodenum, the best results would be secured. Contraction of the transplanted tissue is the thing that causes failure in all of the so-called autoplasmic reconstructions. It has been shown experimentally in the so-called autoplasmic reconstructions that contraction will and does occur if there is not a proper submucosa, even though the structure transplanted may have an epithelial lining.

Whenever we can do a direct anastomosis, we are assured, first, of an ample mucous lining to the reconstructed duct, and, secondly, of a sufficient submucosa and peritoneal surface to prevent contraction. Here, as elsewhere in surgery, circumstances alter cases, and it will not be possible always to do any particular sort of operation. Conditions must be met and the method adopted which best meets the needs in the individual case.

We wish now to add to my former report of seven cases two additional case reports which are embodied in this paper.

CASE I.—A white man, seventy-three years of age, presented himself complaining of pain in the abdomen and jaundice. He had been operated upon and his gall-bladder removed, four years before. Following this operation he was well for only a very short time. His skin remained slightly yellowish, but it was not until two years ago that he began having pain in the gall-bladder region. Then followed a gradually deepening jaundice. In the past three months the pain has been quite severe, there has been more or less constant nausea and occasional vomiting, and a progressive loss in weight.

The general physical examination showed a moderate jaundice, a few coarse rales at the bases of the lungs, a blood-pressure of 180/80, and a large hernia through the scar of the high right rectus incision of the cholecystectomy. There were palpable masses in the abdomen, and the other findings were normal for a man of his age.

Except for a clotting time of six and one-half minutes, the laboratory blood findings

were not abnormal. They showed a faint trace of albumen, and an occasional hyaline or granular cast, and a very few red blood cells and pus cells.

A high right rectus incision was made under spinal anaesthesia and a mass of adhesions freed from the site of the former gall-bladder operation. The dissection of the common duct was extremely difficult, but it was finally exposed for about one and one-half centimetres along its course. It was divided just below a constriction in the duct which showed only a pin-point lumen, this stricture being at the junction of the common and hepatic ducts. The hepatic duct above this stricture was nearly two centimetres in diameter. A transverse section was done, the distal end ligated and the proximal end implanted in the side of the duodenum with a double layer of catgut sutures. Several small stones were removed which had pocketed in the area above the stricture. A small cigarette drain was inserted and the wound closed in layers.

An uneventful convalescence followed. The temperature never went above 100° F., and the jaundice had almost entirely disappeared by the tenth day. There was, however, a very slight yellowish tinge to the skin upon dismissal three weeks after operation, though the sclerae were entirely normal in appearance.

A subsequent report on this patient's condition one month after his return home was that the jaundice had completely disappeared and that he was improving daily.

CASE II.—A white woman, aged sixty-nine, was seen in consultation with Dr. J. Heyward Gibbes. She complained of pain in the upper abdomen and back, of "indigestion" and of "biliousness." The family history and past history were unessential. She stated that she had "always had a weak stomach." During the month prior to admission she had had increasing discomfort in the upper abdomen due to gas and pain which radiated to the right back and shoulder. She had more pain in the left back, however, than in the right. There was considerable tenderness in the upper abdomen for a month before she consulted her physician. The stools had also been light in color for some time.

On physical examination, there was a profound jaundice, a rather bad dental situation, a marked bilateral deafness and a slightly enlarged heart. The blood-pressure was 135/85. In the abdomen there was visible fullness and on palpation there was a crescent-shaped mass in the right half which extended well down into the right iliac region. It was smooth, oval, rather firm, and mobile, with, for the most part, an ill-definable edge, but in the region of the gall-bladder this edge was lost. The remainder of the examination failed to disclose further physical defects.

Under ether anaesthesia, a high right rectus incision was made. The liver was found occupying a very low position in the abdomen and the gall-bladder was tremendously enlarged. The head of the pancreas was indurated and enlarged. The common duct was about two-thirds the size of the duodenum. There were a few adhesions around the head of the pancreas and there was a long band of adhesions running from the base of the cystic duct up over the gall-bladder and across it.

As the pancreas was very mobile we were able to deliver the pancreatic head almost outside of the abdomen. The enlargement in the head of the pancreas was definite and unmistakable; it was clearly evident that the obstruction to the common duct was at this point. My first thought was that we were dealing with a pancreatic stone. This was found to be not true, because a small incision was made directly over the centre of the mass which was carefully stretched open with blunt forceps, and the investigation pushed to such an extent that we could be certain that no stone was present, the question then being, Was it a malignancy of the head of the pancreas or an inflammatory process? It looked macroscopically to be inflammatory. A bit of the pancreatic tissue was taken from the inside of the mass for microscopical examination. It proved to be inflammatory and not malignant. The pathological report of Dr. W. H. Plowden, pathologist for Columbia Hospital, follows:

"There was received a minute piece of yellowish-red tissue which had no particular gross characteristics.

HEPATICO-DUODENOSTOMY

"Microscopic sections show a tissue essentially fibrous in character. This fibrous tissue is quite dense and there are very few infiltrating cells. Those present are small in size, deeply staining, and almost the entire cell is occupied by the nucleus. One side of the section is covered by a single layer of tall columnar cells, as if it may have been part of a duct wall. Scattered through the tissue are a few duct-like structures lined by the same type of tall columnar cells. In a few areas are seen clumps of pancreatic cells arranged like an alveolus. None of these are seen to have direct connection with a duct. No islands of Langerhan were present in the sections."

Diagnosis.—Old chronic inflammatory tissue (scar) in pancreas.

The obstruction to the common duct at this point being apparently complete and permanent, we made an anastomosis between the lateral side of the dilated common duct and the duodenum, very much after the manner in which the above case of hepatico-duodenostomy was done.

The convalescence was entirely uneventful. The temperature never went above 99.3° F. The jaundice had entirely cleared by the twelfth day. The patient's symptoms seemed entirely relieved. The stools were normal in color and the wound cleanly healed. When last seen on March 31, 1930, this patient was apparently completely recovered.

In conclusion we wish to direct special attention to the four cases in which we were able to reconstruct by directly uniting the hepatic duct to the duodenum. There were no deaths in these cases, and all of them have obtained thoroughly satisfactory, symptomatic cures.

Naturally, then, our preference is for the operation of hepatico-duodenostomy whenever this is feasible and there is good, sound reasoning behind it. The hepatic duct is quite large when freed and isolated and has enough body to it to enable one to make a satisfactory suture anastomosis.

In this former paper of mine already referred to there is this interesting statement about one of the cases of hepatico-duodenostomy. "One particularly interesting point about the third case was that the stump of the hepatic duct was so short that, try as I might, it was quite impossible to suture the duodenum to the hepatic duct. Consequently, the gap between the two, which was about one-half inch in length, was bridged by a small rubber tube about the size of a No. 9 catheter. To my intense delight, the tube was passed about the fourteenth day, and, after a slight external drain of bile which lasted for about one month, this patient has remained well ever since."

Of course, the series of only nine cases is a small number, and the four cases of hepatico-duodenostomy comprise a still smaller number from which to draw conclusions. However this may be, we simply present the facts as they are and the surgeons who read may draw their own conclusions. Our position is that the four cases of hepatico-duodenostomy are most suggestive and furnish real food for thought.

NEUROFIBROMA ARISING ON THE PERICARDIAL PLEURA*

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SINGLE neurofibromas of the viscera are relatively rare as indicated by citation of such tumors in the literature. The literature, however, probably does not indicate the actual frequency as the cellular picture has led to their being designated under several names, as, fibroma, fibrosarcoma, gliosarcoma, and endothelioma. Accepting the criteria for classification of Ewing,¹ these tumors are derived from the connective tissue structures of the nerve, the neurilemma, perineurium and endoneurium, but do not show evidence of neoplastic change in the nerve elements themselves though nerve fibres are usually found in the tissue near the pedicle and occasionally filaments are seen deeper in the tumor.

Banse,² under the title of "Intrathoracic Fibroma, Neuroma and Fibrosarcoma," reported one case and discussed ten others, partly from the literature and partly from the clinic in which he worked at Greifswald, all of which were found in the thorax. Of these cases three were undoubtedly neurofibromas; three were spindle-cell sarcomas arising near the vertebral column and possibly had their origin from the perineural tissues; three cases were somewhat doubtful, but were apparently benign spindle-cell growths. One was a ganglionic neuroma and the other a plexiform neuroma in a case of von Recklinghausen's disease. All of these tumors were incidental findings at necropsy or, at most, their presence was only suspected ante-mortem. Gery³ described a pedunculated tumor of 850 grams on the pleura of the left lung overlying the heart. This tumor was revealed only at necropsy. Judging from the histological picture shown by the half-tone illustration, it was an undoubted case of single neurofibroma. Because of the varied designations of these tumors it is not possible to state that no other reports of operative removal of such tumors from the pleura exist. A careful search of the literature would lead one to believe that they are of rare occurrence.

CASE.—The patient (N. F.), was a Filipino house servant, thirty-eight years of age, who was admitted to Walter Reed General Hospital, July 31, 1928. Her family and previous histories threw no light on the condition which is the subject of this report.

Present Illness.—For the past year she had noted pains and tenderness in the joints of the extremities, especially the fingers and toes. During this time she felt that she tired easily. She had been troubled with constipation for many years.

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NEUROFIBROMA PERICARDIAL PLEURA

Physical examination revealed a small Filipino. Height fifty-seven inches, weight eighty-six pounds. Blood-pressure, systolic 110, diastolic 77. The fingers and toes showed rather marked swelling or clubbing due to increase in size of the phalanges. The knees were somewhat stiff. There was dulness and increased voice sounds over the left lower thorax laterally and posteriorly with lagging of respiratory movements in this area. There was moderate periodontoclasia, but otherwise no important abnormality. Röntgenographic examination showed a tumor in the left lower chest which moved with the diaphragm. (Fig. 1.) A general medical survey failed to indicate the character of the tumor and revealed the patient in good condition for operation.

Phrenicotomy was done August 17, 1928, under local anaesthesia. On August 30, 1928, the tumor was removed under gas-oxygen anaesthesia. Exposure was by an inter-

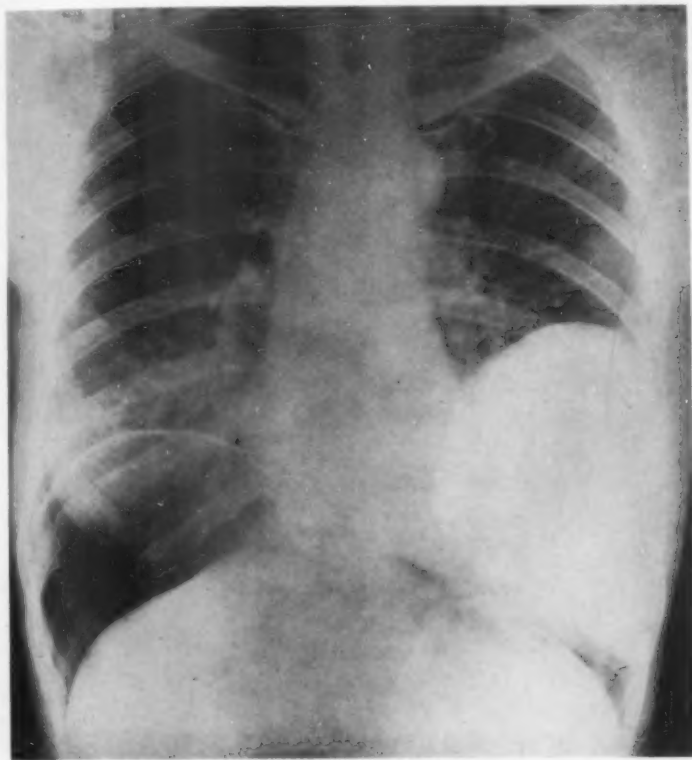


FIG. 1.—Röntgenogram of thorax before operation.

costal incision in the sixth space, extending from in front of the anterior axillary line to a point well beyond the posterior axillary line. The sixth and seventh ribs were divided both anteriorly and posteriorly and turned upward and downward respectively. The incision was spread by means of a Tuffier retractor sufficiently to expose the tumor which was encapsulated with numerous vessels running in its smooth capsule. This tumor was attached to the pericardium by a broad pedicle five centimetres in diameter and to the lower lobe of the left lung by a smaller pedicle two centimetres in diameter. (Fig. 2.) The pericardial attachment was divided between clamps applied successively as division progressed, thus ensuring complete hemostasis. In dividing the pedicle attached to the lung it was necessary to remove a small portion of lung tissue. The damaged lung was carefully repaired with two layers of interrupted fine chromic gut sutures. After the vessels on the pericardial surface had been ligated there remained

a large raw surface somewhat greater than the diameter of the pedicle. Because of the patient's condition it was not deemed advisable to prolong the operation by efforts to reduce his area in size. Three pericostal sutures of silver wire were first introduced to aid in approximation of pleural and intercostal tissues, which were closed by a continuous suture for the entire length of the incision. This suture was not pulled tight and a free loop was left every third or fourth stitch to facilitate closure. The wire sutures encircling the ribs were tightened and after overinflation of the lungs by means of increased positive pressure on the anaesthesia apparatus the pleural suture was drawn tight. The skin was closed with interrupted sutures of silkworm gut without drainage.

There was moderate post-operative shock, relatively easily controlled. The patient ran a temperature of moderate degree for about a week, following which convalescence

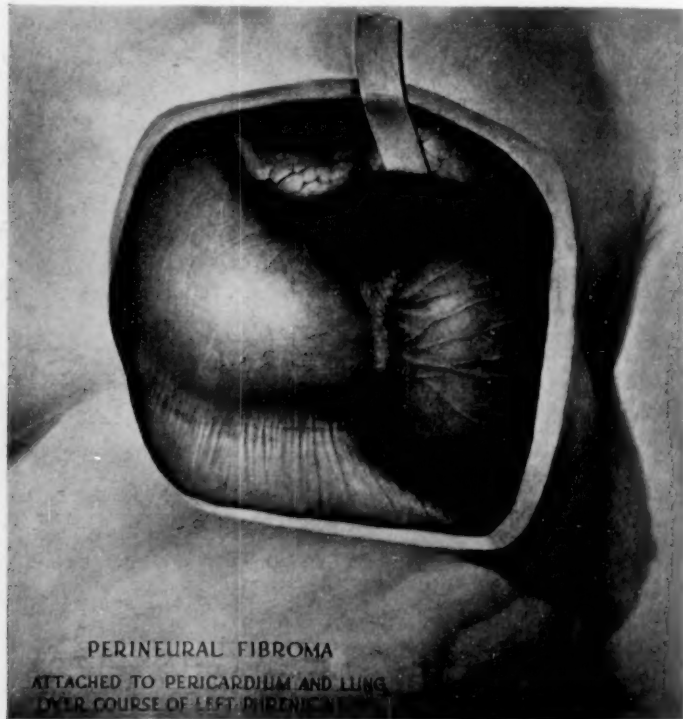


FIG. 2.—Drawing showing the tumor and its relation to the pericardium and lung.

was uneventful. Twenty hours after the operation, 275 cubic centimetres of sero-sanguinous fluid were removed from the chest, and though there was some accumulation after this it did not require removal.

Description of specimen.—Army Medical Museum accession 29631. The specimen weighed 660 grams. It was irregularly oval in shape and measured 14 centimetres in its longest diameter, 11 centimetres in breadth and 8 centimetres in thickness from attachment to periphery. (Fig. 3.) At the upper posterior angle of the area of attachment a small piece of lung tissue was adherent. Vessels radiated around the tumor in the capsule from the area of attachment and were small arteries and larger veins. The capsule was smooth and covered with pleural endothelium. On section the cut surface showed irregular mottling near the capsule of a reddish-gray, translucent tissue with firmer streaks of paler tissue. There appeared to be three masses of tumor—one

NEUROFIBROMA PERICARDIAL PLEURA

above, one below, and a smaller one adjacent to the area of attachment. The main tumor mass showed pale opaque yellow areas surrounded by more dense tissue, the centres of some of these opaque areas being necrotic. There was some blood-filled vessels scattered throughout the tissue. (Fig. 4.)

Microscopical examination.—Sections taken from the pedicle area showed a rather cellular tissue composed of elongated cells of the fibroblast type. Between these is a relatively dense, collagenous matrix. The capsule was pierced by vessels and there were extensions of the tumor cells along these vessels to beyond the capsule, but the vessels themselves appeared independent of the tumor tissue. For a few millimetres beneath the capsule in all sections, the cells were relatively close together, but as the distance from the blood supply increased, collagen became more abundant. In numerous areas the cells were arranged in palisade formation around fibrillar centres, and occasionally these palisade formations surrounded small vessels. (Fig. 5.) The greater part of the dense tissue was formed of bundles of collagen fibrils in more or less parallel arrangement with nuclei between them. This arrangement suggested the picture in longitudinal sections of a nerve trunk, except that there were nerve fibres only in sections from the area of attachment. (Fig. 6.) Here a few medulated fibres were found but elsewhere the collagen masses appeared to be free from actual nerve elements. Mitotic figures were not seen, and while the tumor in some areas particularly near its attachment were very cellular, it did not have the picture of sarcoma.

The histological structure is that of a neurofibroma, the type cell producing collagen as does the ordinary fibroblast, while the arrangement is that of the cells surrounding the fibres and bundles of nerves in a nerve trunk.

This patient presented one condition, aside from the tumor, which was of interest: namely, the swelling or clubbing of the fingers and the stiffness at the knee-joint. The condition of the fingers was that seen in so-called pulmonary osteo-arthritis and presumably it was secondary to the changes produced as a result of the location of this tumor in the chest. There was no indication of cardiac lesion. Brooks and Lehman^{1, 4, 5} have described bone lesions in the neurofibromatosis of Recklinghausen, but in their cases they



FIG. 3.—The tumor, showing area of attachment.

believed that invasions of the bone by the tumor tissue accounted for the major changes in long and flat bones. They do not record the condi-

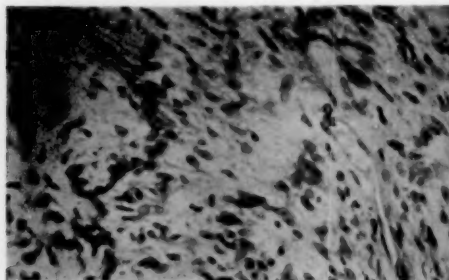


FIG. 4.—Photomicrograph showing palisading of nuclei about bundles of fine fibrils.

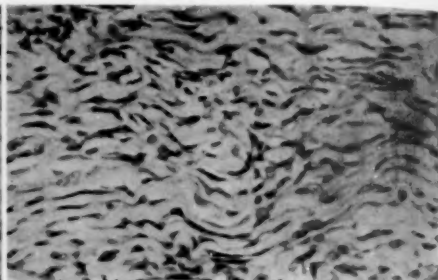


FIG. 5.—Photomicrograph showing parallel arrangement of bundles of collagen fibrils, simulating nerve structure.

tion found in this case, which presented none of the physical signs of Recklinghausen's neurofibromatosis.

In this connection it is interesting to note that the pain and tenderness

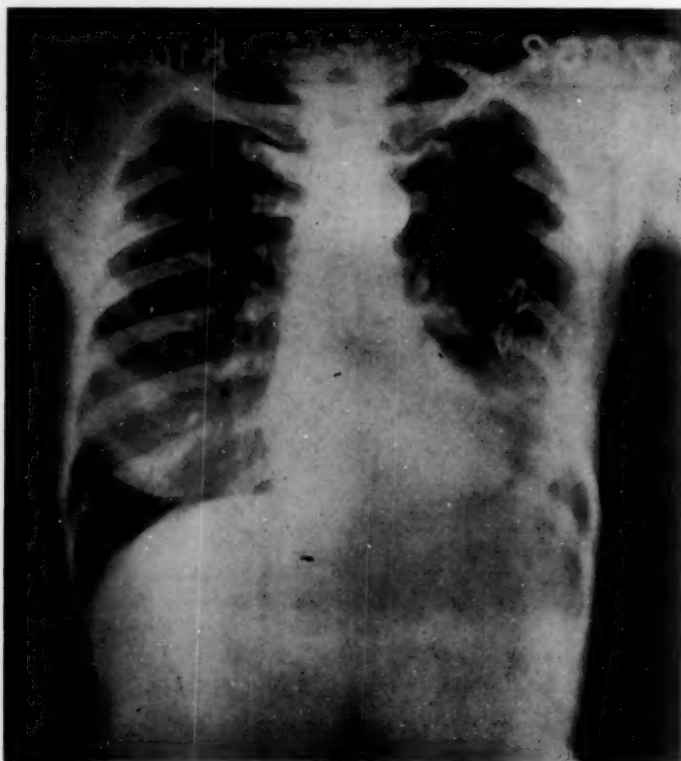


FIG. 6.—Röntgenogram of thorax eighteen months after operation.

of the joints of the fingers and toes and the stiffness of knees complained of prior to operation have completely disappeared, and the osteo-arthritis has shown much improvement. This patient is at present in good health and

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working at her previous occupation of house servant, one and one-half years after the removal of the tumor, and X-ray examination shows no evidence of the return of the growth.

SUMMARY

A case is recorded of single neurofibroma arising on the pericardial pleura over the course of the left phrenic nerve with successful operative removal. The case also presented the bone changes which have been designated as pulmonary osteo-arthritis.

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DISCUSSION: DR. HOWARD LILIENTHAL, of New York, reported the details of a gigantic tumor of the subpleural tissues which he removed last December. This tumor very much resembled the one that Doctor Keller had shown here, and was of about the same size. It was discovered quite by accident. The woman had been operated upon for a pelvic condition by Doctor Heyd of New York who noted at that time a tremendous incurvation of the nails and clubbing of the fingers. X-ray films disclosed almost the exact picture presented in Doctor Keller's case. Doctor Lilienthal operated and found that this particular tumor sprang, as most of these gigantic tumors of the pleura do, from the edge of the pulmonary lobe, but it looked like a lung tumor. In removing it he was obliged to sacrifice a little of the upper lobe of the lung. There was a very large adhesion to the pericardium which was cut through without difficulty, and another adhesion to the anterior chest wall. The patient is now well.

He had also observed and operated upon a gigantic tumor of a similar type which was referred to him by the courtesy of Doctor Woolsey who had operated upon the patient and had taken out a specimen the size of a tennis ball. One pathologist reported the case as one of pure fibroma and another reported it as a fibrosarcoma of extremely low malignancy. The specimen examined by Doctor Klemperer of Mount Sinai Hospital, New York, was pronounced positively non-malignant. The man came back five years later with a softened swollen area near the site of the tumor which was still present. Of course it was impossible to remove this tumor. All he could do was to shell out part of it, and that part was pronounced to be malignant. It had changed its character completely. It was a lesson in prognosis. This patient now has a metastasis in his contralateral lung. In the

first case, the giant tumor of the pleura with adhesion to the pericardium, he was able to remove the entire neoplasm in one piece.

In addition to these two cases he had removed a ganglioneuroma of the first thoracic ganglion in a child. The case has been reported in his book written some years ago ("Thoracic Surgery." Saunders, 1925, pp. 286-290) and the patient has been followed up to the present time, which is now nearly six years without recurrence.

To those of you who are interested in the subject, I will say that Doctor Klemperer and Doctor Rabin have handed in a paper to the American Society of Bacteriologists and Pathologists at their last meeting, which will be published in their transactions. Doctor Rabin went through the literature very, very thoroughly and found only a small number of this type of tumor, that is the gigantic sarcomata of the pleura. I think only two of the cases had been reported as having been operated upon. Most of these patients die on account of the enormous size to which these tumors grow and which produces fatal circulatory changes. For the past few years he had pleaded for exploratory operation in cases of thoracic tumor to me.

DR. MILES F. PORTER, of Ft. Wayne, Ind., recited the history of a woman fifty-four years of age who came to him with a tumor in the region of the sciatic nerve a little above the middle, her chief complaint being peculiar sensations along the distribution of the sciatic nerve below the location of the tumor. When first seen, the tumor was about six inches in length, about four inches in thickness, and was oval in outline. He removed the tumor. It was pronounced sarcoma by the pathologists of the hospital. He found the tumor close to the nerve, but did not think it necessary to invade the nerve in order to make a decently thorough removal.

In a few months she came back with a tumor in the same locality. He again excised the tumor without invading the nerve. The third time she came back. Again he excised the tumor without invading the nerve. Again she came back and this time in order to make what he deemed a reasonably thorough operation, he removed about five inches of the sciatic nerve, dividing the nerve at either end, removing the tumor with the nerve.

All of these tumors were examined by two different pathologists, but in the same laboratory, and they were all pronounced fibrosarcomas.

Five years after the fourth operation a letter was received by him from the patient announcing that the day she was writing the letter was the fifth anniversary of the fourth removal of that tumor and she wanted him to know that she was alive, well, and able to do her own housework.

OSTEOCHONDROMATOSIS

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OSTEOCHONDROMATOSIS is not merely a somewhat rare disease, but is otherwise an interesting affection. It is limited to the synovial membrane of joints, affecting other joint elements and neighboring structures simply by pressure and mechanical interference with function. Bunne (Deut. Med. Woch, 55, No. 27), succeeded in finding only eighty cases in the literature previously to July, 1929. Of these only one was in the hip, but Bunne himself reported two of the hip, both in men over sixty. To these eighty-two cases may be added one of the knee herewith reported, and a number of others unreported of which I have learned by personal communication. But the affection is probably much less rare than indicated by these figures. The affection is generally monarticular, for in only three of eighty-five cases were two joints affected. Of the etiology nothing is known. Lexer and others suggested that it was a congenital affair dating from the period of formation of the joint; there having occurred some sort of interference with the differentiation of the mesenchyme into cartilage and synovial membrane, the late discovery of the abnormal masses of cartilage being accounted for by the extreme slowness of their development. But it is difficult to reconcile this theory with the fact that the pockets and folds of the synovial membrane seem to be sites of predilection and the fact that the trouble is most often discovered in later middle life, too late to make even so slowly growing masses probably congenital although be it said a few cases have given history of trouble with the affected joint beginning in youth. Trauma seems unlikely—at least one can say with certainty that if the disease is to be attributed to a single trauma as is done by many of the victims, the extreme chronicity of the affection and its slow development would exclude any trauma alleged to have occurred shortly before the discovery of the swelling. But chronic irritation of the synovial membrane as from repeated slight traumata in some pernicious habit of striking or bumping the knee repeatedly as in some occupations, would seem to be more promising as an hypothesis.

Boehm (Deut. Ztsch. f. Chir., 212, 1928), discusses at length the four principal theories of the cause of osteochondromatosis, *viz.*, infectious, traumatic, embryonic and neoplastic. He concludes that the disease is of the nature of a non-malignant tumor but that trauma cannot be excluded as a cause. As to the particular points of origin of the process, there are almost as many different observations as authors who have studied the matter.

Examples of change from one form of mesoblastic tissue into another are not unknown and from various causes, *e.g.*, the development of bone in muscle in diffuse myositis ossificans, in which there is no suggestion of

trauma but in which the blood calcium content is abnormally high; the development of bone in a vein long obliterated by thrombosis; the development of a bursa with wall very like synovial membrane under the influence of continued movement in pseudarthrosis and in arthroplasty.

Osteochondromatosis consists essentially of the development of cartilaginous masses on the inner surface of the synovial membrane. These differ in size and form in the same case and in different cases. In most cases they consist of great numbers of cartilaginous buds varying from microscopic size to individual chondromata several centimetres in diameter, commonly with small pedicle and hence often broken off becoming loose bodies in the joint. They seem to be entirely independent of the joint cartilage proper which even in exaggerated cases remains apparently normal. Reichert (*Deut. Ztsch. f. Chir.*, 1900), reported a case in which the new-grown cartilage took the form of large flat plates. There is a marked tendency to the development of bone in the centres of the cartilaginous buds or papillæ as well as unorganized calcification. Since the advent of the Röntgen-ray this fact makes the diagnosis relatively simple though previously difficult. The X-ray picture, showing, as it does, multiple points or masses of calcification in and around the joint but detached from the bones which latter are essentially normal in outline, can hardly be confounded with that of any other lesion. There often is demineralization of the bones of the limb such as is common in non-use, also evidence of pressure effect, but the picture as a whole is very different from those of ossifying sarcoma, budding exostosis, arthritis deformans, excessive callus following fracture, myositis ossificans, etc. It is a curious thing that muscles, aponeuroses and fascias about the joint may be penetrated or rather traversed by the cartilaginous masses and yet there is no true infiltration as in malignant tumors, the collective masses remaining encapsulated. It is as though the cartilaginous masses backed out through areas of least resistance carrying the expanded synovial membrane before them. The skin seems not to have been penetrated in any case thus far reported. Extension is purely by continuity; metastasis has not been observed. There is no abnormal amount of fluid in the joints as in neuropathic arthropathy though the surfaces of the cartilaginous papillæ are moist with normal-appearing synovial fluid, nor is there comparable absorption of the bones giving rise to abnormal mobility. Histological examination shows the abnormal masses to consist of apparently normal cartilage, perhaps somewhat more cellular, with central calcification and bone formation.

Clinically, the cases differ chiefly in phenomena which might be expected to vary with the duration of the process and the size and location of the cartilaginous masses—swelling, limitation of motion, rarely spontaneous pain, possibly some pain in attempting to exceed certain limits of motion, sharp pain, to be sure, when one of the loose bodies, especially if extensively calcified, is caught between the bones of the joint—in the hip there has been reported pain suggestive of sciatica—limping, if in knee, hip or ankle, atrophy of muscles, sometimes contractures, but above all and most charac-

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teristic, the negative symptom of surprisingly little interference with function in view of the size of the cartilaginous masses.

The following case is typical.

R. H. M., aged sixty-nine, an Englishman, an old sailor, fond of the out-of-doors, remembered having strained his right knee seven years ago while tramping in the Sierra Nevada with a pack on his back. Shortly thereafter the knee became swollen and the swelling persisted and slowly increased, with the formation of great masses of firm tissue which he likened to bags of gravel. He had never been disabled, said that the knee would get smaller when he exercised—in fact, he had taken several hard mountain



FIG. 1.—Relative size of knees before operation.

trips on foot since the knee became swollen. There was almost no pain but a good deal of stiffness and discomfort in getting about in the morning, the trouble disappearing as the day wore on, the whole picture, however, slowly progressive.

Examination, July 16, 1929.—A short stocky man not overweight (136 pounds) right knee enormously swollen (Fig. 1) with great "bags" of firm material very suggestive of gravel with grating vibration when touched, the vibration also appreciated by the ear—these masses distending the joint and extending out in various directions, one mass the size of a hen's egg, having perforated the vastus externus muscle and its sheath, lay subcutaneously above the lateral aspect of the joint; others filled the popliteal space obliterating the ham strings and one much larger, of the size and proportions of a fat banana (red variety) extended subcutaneously down the calf for about

fifteen centimetres. Blood Wassermann reaction negative, leucocytes 7,500, 54 per cent. polymorphonuclears, 40 per cent. lymphocytes, urine negative. X-ray films showed normal bone contours, but an infinitude of minute specks, evidently shadows of calcium particles, presenting such a picture as would be given by looking at the Milky Way through the leg if by some miracle it had become transparent. In stereoscopic examination the bones, normal except for some demineralization, seemed to be suspended in a cloud of minute stars.

Under local anaesthesia the subcutaneous mass on the outer side of the joint was exposed. It was completely encapsulated and when incised was found to communicate widely with the upper part of the joint so that the finger was readily introduced. The diagnosis was evident—histological examination showed merely cartilage with calcification, nothing suggestive of malignancy. It was a question whether to perform resection of the knee as is commonly advised or to dissect out the entire synovial membrane and



FIG. 2.—Interior of joint; patella retracted.



FIG. 3.—Interior of supra-patellar bursa.

make an effort to preserve some motion in the joint. The latter procedure was chosen and carried out as follows:

Through a wide horseshoe incision with concavity above, the patella was sawn through transversely and the muscles and fascias divided in the same line. The entire synovial membrane (Figs. 2 and 3) was found to be involved in the process and was excised, even that on the cruciate ligaments and on the posterior aspect of the joint above the femoral condyles. The bone and joint cartilage proper seemed completely normal. To gain access to the posterior parts of the joint and the bursae all the ligaments of the joint were cut except the cruciates. The large mass extending down the calf was removed through a second incision. The dissection was not difficult because of the complete encapsulation of the cartilaginous masses, which were therefore easily shelled out (Fig. 4). Some of the intra-articular masses were attached to the synovial membrane by long fibrous threads; many were loose in the joint. The patella was drilled and sutured with silver wire as in transverse fracture—the ligaments, muscles and fascias with fine chromicized catgut, skin with interrupted silk-worm gut. A small

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rubber dam drain was left in the lateral aspect of the joint for twenty-four hours. No splint was applied but the leg laid in slight flexion over a pillow.

Normal wound healing, patient out of bed on crutches on the fifteenth day. No massage or passive motion was prescribed but patient was encouraged to move the knee actively as much as he could. In three months all swelling had disappeared, the knee appeared perfectly normal with perhaps 10° of active flexion. There was not more limp than would be accounted for by the limitation of motion, lateral stability excellent, but by way of caution patient wore a cane when on the street.

Nine months after operation there was almost no limp, extension was normal, active flexion 45° . There was no sign of regrowth of cartilage, but, of course, the patient could not be assured that some small portions of synovial membrane had not been left behind, or minute bits of cartilage by which the process might be continued.

Final histological examination by Dr. W. Ophuls was reported as showing "clusters



FIG. 4.—Masses of cartilage after removal.

of small pieces of hyaline cartilage which are embedded in fibrous tissue. The cartilage is quite cellular especially at the edges. It is partly calcified and shows signs of beginning ossification."

The cellular character of the cartilage above described and the fibrous tissue accompanying it would seem to speak strongly for an inflammatory origin of the process. The fact that the patient noted the swelling for the first time at the age of over sixty-two speaks against a congenital origin especially since he is something of a sculptor and a good observer of form. Moreover, the fact that the entire synovial surface of the joint was involved further suggests surface irritation as the cause.

DISCUSSION: DR. CHARLES GESCHICKTER, of Baltimore, Md., alluded to the relation of these lesions to certain histogenic processes about the joints, and discussed the mode of extension of this type of cartilaginous tumor. It is not possible to deny a connection between the lesions of osteochon-

dromatosis and normal developmental processes in the tissues, merely on the grounds that they occur most frequently in adults. Nor can it be assumed that because much fibrous tissue is present in the lesion, that this connective tissue is a defensive reaction and that the lesion is therefore inflammatory. As a matter of fact there are fundamental embryonic changes which occur in tissues about the joints, which date back to foetal life, and which persist in the adult in the regions of the normal joint capsule, the normal synovia and at the points where tendons and ligaments attach periarticularly.

These tissue changes which are identical in character in both the embryo and the adult, and which we believe are related to the lesions of osteochondromatosis concern the differentiation of cartilage and bone from a primitive form of connective tissue. This primitive connective tissue which gives rise to cartilage and which subsequently may ossify if irritated or infected, is present not only at birth and in the normal embryo, but persists throughout life. Kölliker, in 1853, showed that cartilage cells and small cartilaginous masses embedded in connective tissue were part of the normal histology of tendons, such as those that attach at the heel and about the knee joint. By excising bits of tissue from the region of the joint and the neighboring tendons and ligaments, we have confirmed the findings of Kölliker and have found in addition that these cartilaginous masses are not restricted to ligaments and tendons, but may be found also at the point of reflexion of the normal joint capsule and in the region of the synovia. The significance of the cartilage and partially ossified material found in these structures must be attributed to the developmental powers of the connective tissue in which they are embedded. This connective tissue retains its primitive power of forming both cartilage and bone, and its persistence about joints accounts for the chondral and osseous masses found not only in chondromatosis of the knee joint, but also in the so-called calcaneal spurs at the heel associated with chronic gonorrhœal arthritis, and for such lesions as calcified bursitis and the osteophytes of the proliferating form of chronic arthritis. Since the synovial membrane is derived from this same connective tissue, it may be involved by the same type of pathological processes.

The extension of the disease of osteochondromatosis, which usually originates in the synovia, into the neighboring ligaments and tendons is in all probability not a matter of extension, but of a further involvement of an identical type of early connective tissue by the same pathologic process. Such a diffuse involvement has been reported by Doctors Jones and Henderson of the Mayo Clinic in a case in which there was not only osteochondromatosis of the knee joint but cartilaginous exostoses above the knee and about the femur at points of tendinous attachment. It is interesting that the cartilaginous exostoses in this case showed histologically the same type of transition from connective tissue to cartilage to bone that was found in the joint mice within the knee joint. In this particular case the exostoses later gave rise to osteogenic sarcoma. This single case in which osteochondromatosis

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of the knee joint, exostosis above the knee and osteogenic sarcoma were all found in the same patient, illustrates very emphatically the close relationship of these various types of new growth to the fundamental transitional processes found in connective tissue and also the close relationship of these various neoplasms to each other. On this basis it can be said that osteochondromatosis is only one of a group of processes that may occur in connective tissue, which retains the power of both cartilage and bone formation. Osteophytes in chronic arthritis, exostoses of bone and even certain types of osteogenic sarcoma may show a similar type of pathology.

The histogenesis of these lesions is easier to trace than their exact etiology. In discussing the etiology of these lesions, he differed from Doctor Rixford in that he believed the location of the growth a more important consideration than the age of the patient. The significance of the location of these lesions within the joint and the occurrence of similar pathologic changes in the immediate vicinity of the joint is that the connective tissue involved by the lesion persists in an undifferentiated form in adults in only such locations. Embryologically, connective tissue which gives rise to cartilage at the site of the future skeleton disappears shortly after the bones have been preformed in cartilage. It is only about joints and periarticularly that strands of this same connective tissue exist for the purpose of taking part in the development of the future joint. Why these strands should continue to function long after the joint structure is complete is not entirely clear. It is also not clear how trauma and infection act in stimulating this undifferentiated tissue to further development. It is nevertheless a fact that both trauma and infection may act later in life to produce true tumors in this tissue and in this respect he agreed with Doctor Rixford that inflammation and injury may be exciting causes. Nevertheless it is important to emphasize that the actual diseased tissue of osteochondromatosis represents an over-stimulation of a normal process and that this peculiar combination of fibrous tissue, cartilage and bone is not restricted to this particular malady.

DR. DALLAS B. PHEMISTER, of Chicago, Ill., said that an unusual feature of Doctor Rixford's case was that so many of the osteocartilaginous loose bodies remained attached. In the cases of multiple bodies that he had seen, the great majority of them have been free in the joint, but the large ones are likely to be attached. The free bodies are nourished by the synovial fluid and increase in size, affording the best example of tissue culture *in vivo* that he met with. There is usually a fibrous peripheral layer which passes over into hyaline cartilage which in turn passes into calcified cartilage. Lamellæ of bone also form which are free of Haversian canals and of bone marrow.

Multiple loose bodies occupying both the anterior and posterior recesses of the joint are best removed through an anterior median incision either splitting or circumventing the patella and through postero-mesial and postero-lateral incisions just back of the ham string muscles on either side.

DR. ERNEST A. CODMAN, of Boston, Mass., said, in regard to the case which Dr. Bloodgood alluded to of a very large osteochondromatous tumor

of the upper end of the humerus, it was not "inadvertently," that he left the chips in the wound. He had disarticulated the joint and excised the tumor to about the mid-humerus, but as the nerves and vessels lay in tunnels in the tumor, chips were necessarily scattered through the tissues. He knew they were there and he cleaned out many of them.

The operation was about fifteen years ago. Many of the chips grew afterward and although they were almost microscopic, they would develop tumors as big as hen's eggs composed of pure cartilage. Some of them even appeared up around the clavicle. These had a myxomatous consistency. After repeatedly removing these small growths, he made a shoulder-girdle amputation. The patient has been well since.

The case illustrates a lesson that osteochondromatous tumors that have bone pedicles should be thoroughly excised rather than have any relation to the particular disease, an instance of which Doctor Rixford had presented.

CANCER OF THE BUCCAL MUCOSA

THE RESULTS OF TREATMENT BY OPERATION AND RADIATION

BY CHANNING C. SIMMONS, M.D.

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AN ANALYSIS OF THE CASES OBSERVED AT THE MASSACHUSETTS GENERAL HOSPITAL AND THE COLLIS P. HUNTINGTON MEMORIAL HOSPITAL IN THE THREE-YEAR PERIOD FROM 1921-1923

IN SEPTEMBER, 1926, I reported a review of the cases of cancer of the tongue, cheek, jaws, palate and tonsils, observed at the Collis P. Huntington Memorial Hospital and at the Massachusetts General Hospital, during the three-year period, 1918-1920.¹ There were 376 cases and the results of treatment by radiation and surgery were studied and reported. These cases were followed for a period of three years from the date of treatment.

The present communication is a study of a similar group of cases observed at the same institutions during the three years, 1921 to 1923, 387 in number, treated by surgery and radiation and followed for not less than five years. The study was made to learn, if possible, what improvement had been made in the results since during this period the technique of radium and X-ray treatment had improved, and the use of larger doses, and of gold and platinum seeds of radium emanation had become general. There were relatively few changes, however, in the surgical treatment, as at this date electro-surgical methods had not been generally adopted.

The author wishes to thank Dr. H. F. Hartwell, of the Massachusetts General Hospital, and Dr. Shields Warren, of the Huntington Hospital, for their assistance in the pathological work and grouping of the cases as to their relative malignancy.

The Committee on Cancer of the American College of Surgeons has adopted an arbitrary time limit of five years to be applied to all cases of cancer before they are to be regarded as a cure, and to conform to this regulation no case is spoken of as a cure unless living and without evidence of the disease five or more years after treatment, and unless the diagnosis was confirmed by microscopic examination.

The groups studied were cancer of the tongue, floor of mouth, cheek, palate, upper jaw, lower jaw and tonsils. Cancer of the lip was excluded as it is a distinct type of cancer much less malignant than the same disease arising in the buccal mucosa, and cancer arising in the antrum was also excluded. All cancers arising from the buccal mucosa have been considered together, however, for although varying somewhat in malignancy according to their situation the tumors are all of the same type and the course of the disease is essentially the same.

The cases may be divided as follows: (see Table I).

¹ Surgery, Gynecology and Obstetrics, September, 1926.

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TABLE I

	Primary No Metastases	Primary Metastases	Recurrent	Totals
Tongue.....	48	89	10	147
Floor of mouth.....	5	15	2	22
Cheek.....	25	25	6	56
Lower jaw.....	15	38	4	57
Upper jaw.....	12	10	4	26
Palate.....	10	12	3	25
Tonsil.....	19	35	0	54
	134	224	29	387

In making this study in the former paper the cards advocated by the Cancer Committee of the American College of Surgeons were used and their classification adopted; and for comparison this paper has been arranged along the lines of the previous communication. For the benefit of those who are not familiar with the classification adopted by the College of Surgeons, I would say that the cases are divided; first, into two main groups, primary and recurrent; and the primary further divided into those with or without evidence of glandular metastases at the time of their first consultation.

There were 387 cases of cancer of the buccal mucosa admitted to the two institutions during the three-year period, as follows: Collis P. Huntington Memorial Hospital, 336; Massachusetts General Hospital, 26; both institutions, 25.

Etiology.—The etiological factors were the same as in any other similar group. Ninety and seven-tenths per cent. of the cases were males, and 9.3 per cent. females. The average age was fifty-nine, and 82 per cent. of the cases were over fifty years of age. There were two patients under thirty, the youngest being eighteen. This latter patient had a cancer of the hard palate. Eighty per cent. used tobacco in some form. Most of these smoked while many chewed as well.

Leucoplakia was noted as being present in 25 per cent. of the cases, and must be considered as a distinct pre-cancerous lesion. It was associated with syphilis in 70 per cent. of the cases in which it was present. The blood Wassermann was taken in 227 cases and was positive in 47, or 20 per cent.

Data in relation to the teeth were available in many instances. In 167 cases it was definitely stated that the teeth were bad, and seventeen patients dated their first symptoms from a bite or cut from a sharp tooth. Three patients stated the disease was brought on by a cut from a foreign body, and twenty-four believed a poorly fitting false tooth plate was the exciting cause of the cancer. This does not necessarily reflect on the dentist, as many of these patients had not had their plates adjusted for years. In ten of these cases the cancer originated on the alveolar process or palate; in nine it was on the cheek, and in five on the tongue or floor of the mouth.

Duration of disease.—Cancer of the mouth is of relatively rapid growth, and the seriousness of the condition is not appreciated by the patient in its

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early stages as it causes little inconvenience and rarely pain. Data on the length of time elapsing from the onset of the disease to the first consultation with the physician were available in 339 cases. Of these, 220 sought advice within one month of the onset, or 64 per cent.; 11.5 per cent. within three months, while 24.5 per cent. delayed for a longer period (see Table II).

TABLE II

Delay First Symptom to First Consultation

	1921-1923	1918-1920
Less than one month (no delay).....	64%	40%
One to three months.....	11.5%	27%
Over four months.....	24.5%	33%

Comparing these figures with those for the three preceding years, there seems to be considerable improvement, probably due in part to the educational and publicity campaign carried on at that time by the American Society for the Control of Cancer.

Three hundred and sixty-eight of the 387 cases were primary; that is, they had received no treatment prior to their consultation at the hospital. Of these, 68 per cent. presented evidence of glandular metastases when examined, while in 134, or 32 per cent. of the cases the disease was confined to the mouth. The average duration of the primary cases with no evidence of metastases was four months; of those with evidence of metastases, 7.2 months. In other words, other factors being equal the duration has a distinct relation to the extent of the disease and to the prognosis. It will be noted that the duration of the cases cured by operation is six months. In other words the relatively slow-growing type of cancer has the best prognosis (see Table III).

TABLE III

Average Duration Primary Cases

Glands not infected.....	4 months
Glands infected.....	7.2 months
Surgical cures.....	6 months

The advice given by the first physician consulted was ascertained in 340 cases. In 211, or 62 per cent., the correct diagnosis was made and proper treatment advised. Thirty-eight per cent., however, received poor advice and were kept under observation for from two months to one year. It seems fair to assume that the condition was not suspected in these cases. In forty-three the lesion in the mouth was diagnosed as simple ulcer from rough teeth and the patient advised to have the teeth cared for. In fifteen other cases with a positive Wassermann, the diagnosis of syphilis was made and the patient treated for that disease, the possibility of syphilis and cancer being associated, apparently having been overlooked.

Definitions of terms employed.—Cure.—No case is spoken of as a cure unless it is living without evidence of disease five or more years from the date of last treatment, and the diagnosis confirmed microscopically. Patients dying of other causes less than five years after treatment are excluded as inconclusive.

Radical operation.—By this is meant the removal of the local growth and a dissection of the glands of the adjacent side of the neck, removing the sternomastoid muscle and the internal jugular vein from the clavicle to the base of the skull together with the contents of the submaxillary triangle. The operation was performed in two stages, with an interval of ten days intervening, the local growth being removed first in most instances. This was done with the knife usually followed by cautery. When excision of the upper or lower jaw was indicated the classical operation was performed, modified to suit the individual case.

Incomplete operation.—Wide local excision of the growth with or without cauterization. This was occasionally followed by implantation of gold seeds of radium emanation. When possible, the local excision was done through the mouth, but, if necessary to obtain a proper exposure, the cheek was split. The incomplete operation was performed in cases which were considered poor surgical risks, in many early cases of cancer of low malignancy and, in a few instances, as a palliative procedure where it was believed possible to remove all the primary growth. These cases were usually accompanied or followed by radium or X-ray treatment.

Radiation treatment.—It has been the policy in both the Massachusetts General and the Huntington Hospitals to treat all early and operable cases of cancer of the mouth surgically, unless operation was contraindicated by the position of the growth or condition of the patient. In most instances radium was employed as gold seeds, containing from one to three millicuries of emanation, introduced about the base of the tumor and allowed to remain *in situ*. The actual method of application of these seeds varied. In certain cases they were introduced in the out-patient department, but in most instances the patient was admitted to the hospital and the treatment given under a local or general anæsthetic. The latter method is much to be preferred and is now being generally adopted. From three to twelve seeds were employed, depending on the size and position of the tumor. Radium was not used when the growth was close to bone on account of the resulting osteomyelitis and severe pain following treatment. Surface applications of radium either as bare tubes or with silver screening were used in certain cases. The glandular areas of the neck were treated by X-ray in preference to radium, both the so-called high voltage and the ordinary treatment being used. As many patients did not report regularly it was found necessary, in drawing conclusions, to judge each case separately and decide arbitrarily whether they had received sufficient or insufficient radiation to accomplish the desired result.

RESULTS OF OPERATIVE TREATMENT

Of the 134 primary cases without evidence of metastases, fifty-four were treated surgically, without operative mortality. Five of these died of other diseases without recurrence less than five years from the date of operation, and have been excluded as inconclusive, and we have been unable to trace two cases for more than three years. There are, therefore, forty-seven cases avail-

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able for study of the end-result. A radical two-stage operation was performed on seven, and an incomplete operation on forty.

The results approximate those reported previously. Forty per cent. of the cases were living without evidence of disease at the end of five years (see Table IV).

TABLE IV

Results of Operative Treatment Primary Cases Without Evidence of Metastases (47 Cases)

	Cases	Five-year Cures	Per Cent. Cures 1921-1923	Per Cent. Cures 1918-1920
Tongue.....	23	8	34	26
Floor.....	3	1	33	25
Cheek.....	7	2	29	66
Upper jaw.....	5	4	80	50
Lower jaw.....	7	2	29	43
Tonsil.....	1	1	100	0
Palate.....	1	1	100	—
Totals.....	47	19	40	34.7
Cures following radical operations.....			33	35
Cures following incomplete operations.....			42	34
Operative mortality.....			0%	2%

There is a slightly larger proportion of cures of cancer of the tongue with a smaller percentage of cures in cancer of the cheek and lower jaw. The one case of cancer of the palate and cancer of the tonsil operated upon were cured, but in both instances these were very early tumors.

It will be noted that there is a larger percentage of cures following incomplete operation than following radical operation. This is probably to be accounted for by the fact that in cases of very early cancer or cancer of the papillary type, the most favorable causes for cure, local excision only was done.

Twenty-eight cases that showed evidence of metastases were subjected to surgical operation. In ten a surgical cure was attempted with an operative mortality of one case (10 per cent.). Of the remaining nine, one has not been traced and is excluded, and three are living without evidence of disease (33 per cent. of the operative cures). The presence of cancer in the glands was confirmed by the microscope in all these cases, and the three cures were all of a relatively low grade of malignancy.

Eighteen cases showed clinical evidence of glandular metastases and an incomplete operation was done as a palliative measure, combined in some instances with the implantation of radium seeds. There was one post-operative death, and one case has not been traced. The remaining sixteen cases are dead of the disease, as was to be expected, although in three there was no local recurrence before death and, I believe, in most instances, life was prolonged and made more comfortable by the operation. Both of the operative deaths followed excision of the lower jaw (see Table V).

Prophylactic post-operative radiation.—The number of cases is insufficient to allow conclusions to be drawn as to the value of prophylactic post-operative

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TABLE V

Results of Operations on Primary Cases with Evidence of Metastases

	Cases	Operative deaths	Untraced	Cures	
Radical operations.....	10	1	1	3	33 per cent.
Palliative operations.....	18	1	1	0	0 per cent.

X-ray. Of the radical operations, five cases received post-operative X-ray treatment, of which two are living and three are dead; while seven cases received no X-ray treatment, of which three are living and four are dead. Of the cases in which there was no clinical evidence of metastases and on which an incomplete operation was performed, eighteen received prophylactic X-ray to the glandular areas of the neck and only one of these is living. Of the twenty-four cases in this group who received no X-ray treatment, sixteen are living. I do not believe that it is justifiable to draw any conclusions from these cases, as it is probable that the more extensive ones only were referred for post-operative X-ray treatment, but it would appear from studying the entire group that prophylactic post-operative X-ray treatment had little effect in preventing or controlling the glandular recurrence.

RESULTS OF RADIATION TREATMENT

It is more difficult to tabulate the cases treated by radiation than those treated surgically. I have applied the same rules as were enforced in analyzing the surgical cases; namely, no patient is considered cured unless the diagnosis was confirmed by pathological examination and he is living without disease five years after the last treatment.

Primary cases with no evidence of metastases.—There were forty-five cases in this group who received sufficient radiation in the form of radium to the local growth. About one half of these cases received X-ray treatment to the glandular areas of the neck as well. As the numbers in these two groups are small and there is no appreciable difference in the figures they are considered together.

Of the forty-five cases available for study, nine have been excluded, as the patient either died of other disease within the time limit or, if living, no pathological report was available. Of the remaining thirty-six, three, or 8½ per cent., are to be regarded as cures. These three cases were: one of carcinoma of the cheek, one of carcinoma of palate, both papillary in character and of low malignancy, and a third of carcinoma of the tonsil, which, although papillary in character, was graded pathologically as of high malignancy. This 8½ per cent. of five-year cures following radiation treatment is to be compared with the 40 per cent. of cures of cases in the same clinical group following surgical operation. There is one other case of cure following radiation treatment, that of a small local recurrence following operation.

In studying these cases treated with radium, individually, the results at first glance seem better than those reported. In five of the cases the patient

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died of metastases in the glands within three years from the time of treatment, but the local growth had been destroyed by radium and did not recur within this time; in other words, the radium had probably done to the local growth all that could be expected. In six other cases spoken of as cures in the records, and in which the local growth was apparently destroyed, the diagnosis was not confirmed by pathological examination and there is a definite question as to whether cancer was present or whether the growth was a papilloma or leucoplakia.

Primary cases with metastases clinically in the glands.—There were 138 cases in this group. Twenty-three were not traced, four died of intercurrent disease shortly after treatment and are excluded, and the remainder, 111, died of cancer. There were no cures. This may be compared with the thirty-three per cent. of cures in a similar group treated surgically. It is admitted that the cases submitted to surgery, although in a similar group, were possibly more favorable, but the fact remains that there were no cures following radiation treatment. In analyzing the cases further it is found that there were six cases in which the local growth had been apparently destroyed. Of these six, two died of intercurrent disease within two years of the time of treatment, two died of glandular metastases, although the local growth was eradicated, and two others are living at the present time but the diagnosis was not confirmed by pathological examination and is questionable (see Table VI).

TABLE VI

Radiation Treatment

Primary cases—glands not malignant clinically	
Cases	36
Cures	3 (8½ per cent.)
Primary cases—glands clinically cancerous	
Cases	111
Cures	0

Local recurrence following radical operation.—There were three cases in this group treated with radium: one has been lost track of and the other two are both living; one, however, has to be excluded as there was no pathological examination of the tissues and the diagnosis is questionable, as the indurated area treated was probably only scar tissue, while the other, a case of carcinoma of the tongue, should be regarded as a cure.

Prolongation of life by treatment.—There is no question but that in cases in which a cure was not effected by either surgery or radiation the cases were benefited by treatment and life considerably prolonged. This held true in all the groups. The prolongation of life was somewhat greater following surgical treatment than that following radiation, although the operative mortality (2 per cent.) must be taken into account (see Table VIII).

Reoccurrence.—In a previous article, I mentioned certain cases in which the buccal mucosa appeared to have a predilection to undergo malignant

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TABLE VII

Prolongation of Life by Treatment—Cases Dying of Disease

	Average length of life
Primary cases—glands not malignant	
Following operation	17 months
Following radiation	12 months
No treatment	6 months
Primary cases—glands cancerous	
Following operation	14 months
Following radiation	10.6 months
No treatment	5 months

changes, and although one cancer might be cured, a second might form in a different part of the mouth and have no relation to the primary growth. This is more apt to occur when there is leucoplakia or in a syphilitic tongue. There were five cases in this series which may be termed cases of reoccurrence; three of these patients had syphilis and leucoplakia. In three the second cancer did not develop until six years after the first had been removed, and in none of these was there any evidence of recurrence of the primary growth. Three of these cases were cancer of the tongue. The history of two of these cases is instructive. In one, a cancer at the foot of the anterior pillar of the fauces was removed in 1921. Three years later a cancer developed in a similar situation on the other side and the patient died six months later of cancer of the lower end of the œsophagus. A second case was operated upon in 1908 for cancer of the lip. In 1920, a cancer of the tongue was removed surgically, and in 1927 he developed a cancer of the other side of the tongue from which he eventually died. The histories of the other three cases are somewhat similar to those cited.

Pathology.—At the present time it is generally considered that, other things being equal, the degree of malignancy, as determined by microscopic examination, is the most important factor in determining the prognosis.

A study of the pathological material of the cases was made in order to ascertain the relation between the degree of malignancy and the prognosis in this series of cases but, unfortunately, a specimen was available in relatively few of the cases treated by radiation. Four degrees of malignancy were recognized as suggested by Broders, and the cases were grouped in a similar manner to those reported in the previous communication. The criteria determining the grade of malignancy is shown in Table VIII.

TABLE VIII

Criteria for Pathological Grouping

1. The amount of differentiation of the cells and keratinization
2. The irregularity in size and shape of the nuclei
3. The tendency to deep infiltration
4. The number of mitotic figures

The specimens were reviewed, arranged in four pathological groups, and the results following surgical treatment are shown in Table IX.

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TABLE IX

Results of Operation—Pathological Grouping

	Cases	Cures	Per Cent. Cures
Group 1.....	13	8	62
Group 2.....	17	8	45
Group 3.....	7	1	14
Group 4.....	4	0	0

These results are similar to those previously reported and confirm those of other observers working with cancer in other situations. How this should effect the treatment of a given case is still somewhat problematical. In general it may be said that if the tumor is small and of low malignancy a local excision without glandular dissection should effect a cure. If the tumor is of moderate size and of low malignancy the radical two-stage operation may be done with some hope of cure. If the tumor is small and of high malignancy, the radical two-stage operation should be performed with very wide removal of the growth, although the prognosis is much worse than that of a larger tumor of a lower degree of malignancy. If, however, the tumor is of moderate size and of high malignancy, local excision or radiation treatment only is permissible, as it is apparently impossible to obtain a cure in this type by surgical operation.

In Table X the results are shown in a manner somewhat different from that in Table IX.

TABLE X

Results of Operation—Pathological Grouping Incomplete operations

	Cases	Cures	Per Cent. Cures
Group 1.....	11	5	46
Group 2.....	12	6	50
Group 3.....	6	1	16
Group 4.....	3	0	0

Radical operations

Group 1.....	2	2	100
Group 2.....	6	3	50
Group 3.....	1	0	0
Group 4.....	1	0	0

Specimens were available for review and grouping in only eleven cases, treated by radiation, in which the disease was confined in the mouth. There were two cures, one in a case of low malignancy and the other in a case of high malignancy (see Table XI).

TABLE XI

Results of Radiation Treatment—Pathological Grouping No clinical Metastases

	Cases	Cures	Per Cent.
Group 1.....	3	1	33
Group 2.....	2	0	0
Group 3.....	3	0	0
Group 4.....	3	1	33

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Specimens were reviewed from twenty-eight other cases treated by radiation in which there was clinical evidence of metastases, but there were no cures. The majority of these cases were of relatively high malignancy (see Table XII).

TABLE XII
Results of Radiation Treatment—Pathological Grouping
Metastases present clinically

	Cases	Cures	Per Cent.
Group 1.....	3	0	0
Group 2.....	6	0	0
Group 3.....	8	0	0
Group 4.....	8	0	0

The number of cases in these groups treated by radiation is so small I do not feel justified in drawing conclusions from them.

SUMMARY

1. The results of treatment of carcinoma of the mouth by surgery and radiation at the Collis P. Huntington and Massachusetts General Hospitals for the years 1921-1923 were similar to those obtained in the three preceding years, although the results following radiation treatment were somewhat better, probably due to improved technic.

2. In primary cases without clinical evidence of metastases, surgical treatment offers 40 per cent. chance of a five-year cure as against 8½ per cent. by radiation treatment.

3. In primary cases with clinical evidence of metastases radiation treatment offers no chance of permanent cure, and operative treatment 30 per cent. These figures are hardly fair, however, as only the most favorable cases were submitted to surgical treatment. On the other hand, no cases were cured by radiation.

4. Post-operative prophylactic X-ray treatment had no effect in preventing recurrence.

5. Of the primary cases dying of recurrence, life was prolonged by treatment but life is longer following surgical treatment than radiation treatment.

6. In the recurrent cases dying of disease and in inoperable cases, life is distinctly prolonged by radiation treatment.

7. The patients consulted a physician somewhat earlier and the diagnosis was made more promptly than in the preceding group.

8. Other factors being equal, the prognosis depends on the degree of malignancy of the tumor as determined on microscopic examination.

9. The mucous membrane of the mouth in certain individuals seems to be prone to undergo malignant changes, and multiple cancer is not uncommon.

DISCUSSION: DR. VILRAY P. BLAIR, of St. Louis, Mo., said that since two years ago, when he reported his own cases of mouth and lip carcinoma, he had added to that 160 cases. In all things, his observations agree compara-

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tively with Doctor Simmons'. He had not seen any improvement in the class of cases sent in for operation. Possibly this may mean that the better cases are being held back and he was getting the worst end of it. That is probably the explanation of that.

The most important point brought out by Doctor Simmons is that idea of emphasizing the period of relief given to the patient by proper treatment rather than cure. If we confine our treatment to cases that promise a cure, we will not help many, but dwelling on the theory that this is probably the most important period of a producing man's life, unless he is very old, two or three or four years added to that man's life adds that much to his most productive period. This thought gives much more enthusiasm about treating cancer of the mouth.

Dismissing the idea of confining our attentions to only curable cases, we are seeing very encouraging results in the use of the radium emanations on the tongue and floor of the mouth. Our operative mortality remains very high because we undertake to operate on most extensive cases on the theory that there is a 100 per cent. death rate if they are allowed to go on, and every comfortable year added is a year of useful life added. Whether we like it or not, we are being driven into treating extensive cancers on the inside of the mouth more and more with radium emanations because the patients are less willing to stand for mutilating operations, especially operations on the tongue.

This point comes up: with our high operative mortality, even though we probably will give those people a longer relief if they survive operation, he wondered if the shorter relief that comes from radium with practically no death rate is not going to be a strong argument for the use of radium, especially in the grade four cases.

The point Doctor Simmons brought out about the development of new cancers in various areas is of great importance and explains more recurrences in well-operated cases than the simple continuation of the original growth. It has been his observation that very few mouth cancers of high grade will live beyond ten years, and that almost all of them that have survived the immediate post-operative period have died as a result of a growth developing in some other part of the mouth or in some other part of the body. These might or might not be considered metastatic but they are not part of the original growth.

DR. WILLIAM B. COLEY, of New York, remarked that in cancer of the mucous membrane one has to choose the method of treatment largely by the individual case. At present he believed most cases can be treated best either by radium or by radium combined with surgery.

He had had two cases of cancer of the tongue that might well be recorded in connection with Doctor Simmons' paper. The first one, in which the disease involved the tongue, the floor of the mouth, and the glands of neck, came under his observation twenty-seven years ago. For this he did a two-stage operation. (1) He made a Y-shape incision, removing the submental

glands and all the muscles of the floor of the mouth, following this by a tracheotomy. (2) Ten days later, after packing the pharynx with gauze, he removed the anterior and greater portion of the tongue, cutting the fraenum in order to mobilize the stump. The patient made a good recovery, and was able to talk sufficiently well to earn his living as an insurance agent. Seventeen years later he returned to the Memorial Hospital with a small epithelioma of the nose, which was cured by radiation. He died about a year ago of nephritis, without having had any return of the former trouble. It was then about twenty-six years since the operation had been performed. The microscopical diagnosis of epidermoid carcinoma with involvement of the glands had been confirmed by Doctor Ewing.

The second case was a carcinoma situated in the left side of the tongue about one inch from the tip. He removed one-half of the tongue but, as there were no glands palpable, no dissection of the neck was performed. He advised the patient to take a course of toxin treatment (erysipelas and *B. prodigiosus*) as a prophylactic. He was extremely nervous and after a few doses, he refused to take any more. About six months later he again presented himself with a nodule the size of a hickory nut in the upper cervical region on the left side. This was removed, and Doctor Ewing pronounced it an epidermoid carcinoma. No dissection of the neck was made. The patient was immediately put upon toxin treatment (erysipelas and *bacillus prodigiosus*) which was kept up for nearly six months with occasional intervals of rest. He remained well for more than thirteen years, when he returned with a small nodule in the centre of the scar directly opposite a sharp-edged tooth. The implantation of gold seeds caused apparent disappearance of the tumor within a few weeks. About two months later the nodule reappeared; it was indurated and typically carcinomatous. An extensive operation with a cautery knife was made which was followed two or three days later, on account of profuse hæmorrhage, by ligation of the external carotid artery. The patient was given another course of toxin treatment as a prophylactic. He has remained well up to the present time, slightly over three years since the last operation.

This makes two cases of carcinoma of the tongue that have remained well for twenty-five and sixteen years, respectively, since the operation. Inasmuch as Doctor Simmons' series contains no case of cure after glandular involvement has taken place, these cases should be of considerable interest. In the second case there can be little doubt but that the post-operative toxin treatment was largely responsible for having kept the disease under control for so many years.

DR. MARTIN B. TINKER, of Ithaca, N. Y., called attention to two phases of this question that had not been mentioned. One is the use of electrocoagulation and electric cutting in the removal of these malignant growths.

By electrocoagulation one can close off the lymphatics and the bloodstream and in that way lessen the risk of metastasis.

The second point which had impressed him was that the treatment of

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certain of these cases is not surgical alone or radiological alone, but the combination, radiological and surgical. In some advanced cases not all of the growth was removed, and personally he does not any longer do extensive resections; but these patients afterward were given radium treatment immediately, not a long while after: in some instances the cures last for fifteen years.

The paper recently written by Doctor Forsell, of Stockholm, published in *Acta Radiologica, Supplementum two*, is in his opinion the most complete study that has been made with regard to the treatment of malignant growths by radium. Doctor Forsell emphasizes the point which I have tried to bring out, that in certain of these cases the best treatment is surgical, in some others radiological, and in still others a combination of surgery and radium gives the best results. He has also emphasized this point: that in the radium Hemmet at Stockholm the experienced men get a very much higher percentage of cures than the man who is without radium experience, and this work is delegated there to men who devote a large part of their time to it.

Doctor Tinker's own successes had come where the radium treatment had been given in places like that of Kelly at Baltimore and the Memorial Hospital in New York City where there are men who are devoting practically their entire time to the use of radiological methods of treatment.

PROFESSOR GUNNAR NYSTROM, of Uppsala, Sweden, said that they had made large investigations about the treatment of cancer in Sweden. The most extensive of them was made by the Cancer Society in the years of 1911 and 1913. About ten thousand cases of cancer were assembled from all the doctors, who gave the statistics of the results. This investigation of about ten thousand cases is a basis for the comparison now of the new results. Special investigations have been made as to cancer of the mouth, the surgical treatment and radiological treatment and combined treatment. There is a marked improvement in the results by this combination of which Doctor Tinker spoke, about 38 per cent. of cures by the surgical treatment alone and 50 to 60 per cent. by the combined treatment.

DR. CHANNING C. SIMMONS, of Boston, Mass., remarked that it is in the cases of cancer of high grade malignancy that radiation treatment is used. This type of tumor is radio-sensitive, and unless the growth is very small there is little hope of curing the patient by surgical procedures.

FURTHER OBSERVATION UPON THE COMPENSATORY USE OF LIVE TENDON STRIPS FOR FACIAL PARALYSIS

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SECTION or other type of transverse injury of the seventh cranial nerve proximal of the pes anserinus can, as a rule, be largely corrected by a nerve anastomosis, but even this is not free from trials both to the patient and the surgeon. If seen during the first twelve months after the damage is done, there may be some doubt as to the amount of spontaneous recovery to be expected, and even after an anastomosis is made, one may have to wait eight to twelve months before returning innervation is evident to the patient. It is not ordinarily practicable to do a suture of the smaller branches of the seventh nerve.

The most apparent objective evidence of a unilateral facial paralysis is not due to lack of movement of the paralyzed side so much as to the overactivity of the unparalyzed side and to a gravity sagging of the face on the affected side. The amount of this distortion varies considerably in individual cases but is as a rule most marked in the adult in whom a complete nerve severance has occurred in infancy or early childhood (Fig. 1). Even where there is a complete destruction of the nerve, in the removal of a malignant parotid tumor, which seldom happens before middle life, shortening the face tissues will largely control the distortion. Complete severance of the cervico-facial branch in the parotid is not very noticeable. Complete section of the temporo-facial division or even of the maxillary branch is more noticeable. It is possible to favorably influence the appearance of an evident hemiparalysis of the face by some means that will help to control the overaction of the unopposed muscles and the sagging of the unsupported face tissues.

Live strands of tendon leading through the face can be made to prevent the overactivity of the unaffected muscles, and can be used at any time, relieving a large amount of the visible damage. Even where a nerve transplant has been or is to be done, the tendon transplants take the edge off of the waiting period. With care, even total absence of the nerve can be almost completely hidden.

The paralysis of the orbicularis palpebrarum is compensated or camouflaged by the partial movement of the lids that is always present, but a sagging of the lower lid may suggest the need for some support at its base. This may be accomplished by running a fascia strand to the aponeurosis of the occipito-frontalis (Fig. 4-D and E).

The corner of the mouth can be lifted and the orbicularis oris anchored by tendon strips that engage in the face tissues at the temple or near the

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ear, and a tendon loop can be made to support the lower lid or any particular sagging feature. But a sagging of one side of the face as a whole may require a removal of some of the stretched tissue as well as tendon implantation, the former of which is helpful to almost all tendon insertions for a complete paralysis of one side.

For correction of the sagging lids, the "lift" may be extended across the brow to the mid-line (Fig. 5). The tendons should be put in carefully and in sufficient number. Experience has proved it is better to place all tendons before tightening any of them (Fig. 3-A, B, and C).

Habit distortion might not be entirely relieved by fixation of the unopposed muscle (Fig. 2-B and C). In some of these cases the distortion is not originally great, especially in partial paralysis, and the correction must be correspondingly accurate. The side view of patients so treated makes an interesting study (Fig. 1-C and D).

Illustrations, Figs. 1 to 9, on following pages:

FIG. 1-A.—Woman, with face in repose, who, at birth, had a lesion of the right motor facial nerve from which she made no recovery.

Note that the right eyebrow and upper and lower lids are at a lower level than on the left; that the right cheek and right side of the mouth have sagged downward; and that the lower part of the nose and both lips are drawn over to the left. The sagging of the brow, lids and cheek results from the toneless tissue yielding to gravity, but the displacement to the left results not only from a yielding of the paralyzed muscles to the normal pull of their opponents but appears to be partially due to an overactivity of the latter muscles, as if extra strong impulses were being sent through the normal nerve in an uncoordinated attempt to make up for the lack of movement of the other side.

It is the combination of these two displacements that causes the most evident deformity; when the paralyzed tissues are strengthened and held in their proper position, the patient can usually learn to control the overtone of the sound muscles and there is enough movement transmitted to the paralyzed side in any activity of the muscles of expression to camouflage the fact that the paralyzed side is without spontaneous movement. The incomplete working of the eyelids is the only evident reminder that remains.

FIG. 1-B.—Same patient as shown in Fig. 1-A, after the insertion of tendons and raising the face tissues by removing a strip of skin and subcutaneous tissue superficial to the parotid and temporal fascia immediately in front of the ear and in the hair-line of the temple. (See Fig. 5.) When we first undertook the use of fascial strips* for this purpose, we thought their proper insertion would be sufficient to fix the paralyzed tissues in the desired position, but, even after putting in the strips in a way to cause quite a bit of immediate over-correction, the latter was but partially successful, and it was found that a lifting of the face tissues to put greater traction on the tendons (Fig. 4-B and C), or the insertion of more tendons (Fig. 3-B and C) would be required.

In paralysis of long standing with as much sagging as is shown in Fig. 2, it is well not to attempt to "gather" all of the loose tissues with the tendon loops but to engage only the median three-fourths or more and remove excess, as described above, at the same operation.

FIG. 1-C and D shows the lateral view of the patient shown in Fig. 1-A and B and the amount of correction of the sagging obtained. Note that before the correction, the sagging of the cheek is so great that the vermilion borders of the corner of the mouth are not visible in profile.

* Blair, V. P.: Notes on the Operative Correction of Facial Palsy. Southern Med. Journal, vol. xix, No. 2, pp. 116-120, February, 1926.

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FIG. 1.



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A

FIG. 2.

B



FIG. 2-A.—Patient, who, at eighteen months, had complete transverse lesion of the facial nerve with no recovery. She has an excessive sagging of the face, but, in repose, not much lateral distortion. FIG. 2-B.—However, with any play of the facial muscles, there was a spasmodic overactivity that was very disfiguring.

In this patient, at the first operation, tendon loops were placed in the face and a wide strip of superficial tissue removed from in front of the ear and from the temple but, because she could not learn to overcome the habit of spasm, the inframandibular branch of the right nerve was later cut to stop the downward pull of that side of the lip.

C

D



FIG. 2-C.—Comparing Fig. 2-C with 2-B, it will be seen that, though sag has been removed from the cheek and upper lip, and that the philtrum and the centre of the lower lip remain in the mid-line, and that downward pull of the left lower lip has been eliminated, there is still considerable overactivity of the left buccinator. This is the only case of ours in which this overactivity of the sound muscles has remained objectionably evident after properly fixing the unparalyzed half of the orbicularis oris by tendon loops.

FIG. 2-D, shows the patient's face in repose after inserting the tendons and removing excess tissue on the right side. Note that the sagging of the right lower lid has been partially corrected. Note also a slight eversion of the right side of the lower lip due to the fact that the upper strand of the lower orbicularis loop was placed too far away from the free border of the lip.

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FIG. 3-a.—Shows a young girl who had a complete lesion of the left facial nerve at birth. In this case, the brow on the unparalyzed side is the lower of the two, due possibly to a spasm of the orbicularis palpebrarum.



FIG. 3-b.—In this patient the attempt was made to correct the deformity by the use of tendon loops with the result shown in the above picture taken five months after operation.



FIG. 3-c.—Six months after the first operation, other loops to the corner of the mouth and to the upper and the lower attachment of the orbicularis were inserted, again with over-correction. While the mouth now remains straight and in the mid-line, it will be seen that the "gathered" fullness of the cheek on that side is still quite apparent. The final condition of the eye in this and the two preceding cases will be referred to later.

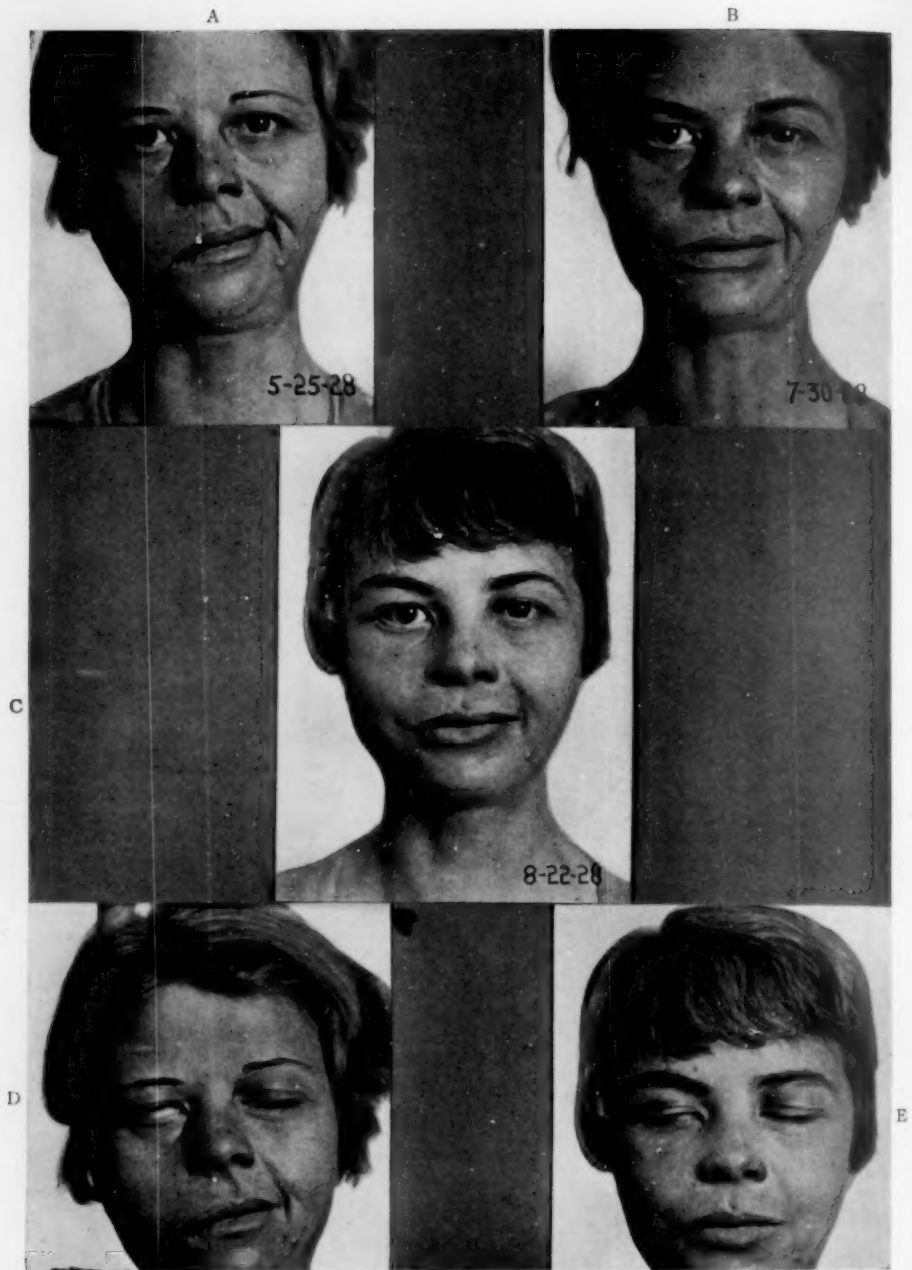


FIG. 4-A shows a young woman who had her right facial nerve cut distal to the division at the "Pes." A subsequent nerve-suture had been attempted and abandoned before entering this service.

FIG. 4-B shows the result of inserting tendon loops with great immediate over-correction.

FIG. 4-C shows final result obtained in part by a subsequent removal of a strip of face tissue from in front of the ear, from the temple, and also along the hair-line of the forehead to across the centre of the brow. At the same time the right side was undermined to allow of freer raising of the forehead tissues and of the tendon that loops around the lower lid. See Fig. 4-D and E.

FIG. 4-D.—Same case as shown in Fig. 4-A before operation, but with the eye shut. Note that the brow and fissure are both markedly displaced downward.

FIG. 4-E shows the result of the operation described under Fig. 4-C. Note that the brow and fissure are at the same level as their fellows and that the vertical extent of the fissure when closed is very much less than in 4-D.

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FIG. 5.—For illustration of enlarged Reverdin needle which we use for inserting these loops, see original article.* The slight modification of the opening and closing mechanism which we resorted to gives leverage in moving the stilet through the irregularly curved tube, and the changes of position of the lever are so evident that, even under the stress of putting in the loops without contamination, one is less apt to withdraw the needle without closing the eye.

The forehead—infra-orbital loop—may be inserted with the Reverdin needle along the base of the lower lid at the level of the infra-orbital border. This can be done with the large Reverdin needle through a small supplementary incision opposite the middle of the infra-orbital border but it is better to use a large "surgical" needle or a specially shaped old-fashioned "perineal" needle on a handle. Fig. 5 also shows a general plan of excision for the excess tissue.

To insert the upper loop, a five-millimetre incision is made well through the skin at a point external to the outer canthus, and another is made vertically, halfway through the orbicularis muscle just beyond the border of the philtrum on the opposite side. The opposite side of the upper lip is fixed by grasping it with a Jacobs forceps which is left locked in place. The unthreaded needle enters at the upper opening, traverses the cheek deeper than the skin, passes deep to the ala labial crease and traverses the lip equidistant from the skin and the mucosa. It emerges through the cut on the other side of the philtrum; one end of a strand of fascia is locked in, and the needle withdrawn, the protruding lip-end of fascia being held with a forceps and protected from salivary contamination by damp gauze; the upper end of the strip is fixed to a damp gauze pad with an artery forceps, the pad itself having been previously fixed to the head towel—this to prevent accidental withdrawal of the strand. The empty needle is then reinserted through the upper incision and traverses the cheek at a lower level than previously. It passes close to the corner of the mouth within a few millimetres of the mucosa of the vermilion border to emerge through the original opening in the lip. The other end of the same tendon is locked in and the needle withdrawn. A Jacobs forceps is locked on the lower lip and, after making appropriate skin incisions, this same procedure is repeated in placing the fascia loop to the corner of the mouth and in the lower lip. In placing the lower lip loop, the upper bar of the loop must run close to the corner of the mouth and just within the vermilion, and the lower strand must be in the movable part of the lip, not in the more fixed tissues of the chin.

The loops are all placed before any are tightened and fixed, and the Jacobs forceps remain locked in the upper and lower lips to assist in the over-correction in tightening and fixing the loops. The exact position of the lip and corner of the mouth loops may change in different cases but the close approximation of lower strand of the upper, and upper strand of the lower lip loops to their respective vermilion borders is a matter of importance.

The positions of the incisions of insertion will vary with the amount of sagging and will also be governed by the length of the tendon strands. Short strands can be spliced with split silk, but it is advantageous to use a single loop when practicable.

* Blair, V. P.: Notes on the Operative Correction of Facial Palsy. Southern Med. Journal, vol. xix, No. 2, pp. 11-120, February, 1926.

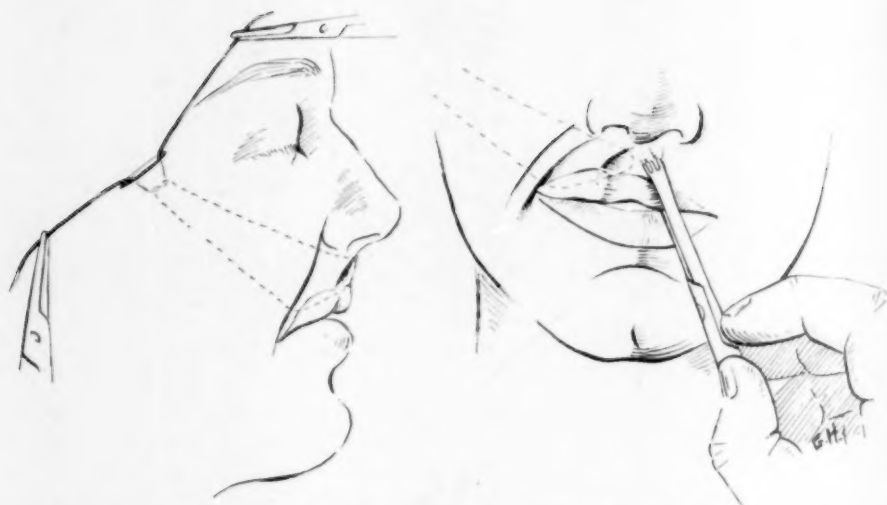


FIG. 6.—Drawing the lips over towards the paralyzed side by means of the Jacobs forceps, the two lip and the corner-of-the-mouth loops are each in turn tied in a single knot, Fig. 6, which slips into the tissues through the skin incision and is drawn taut until there is about 1 centimetre of over-correction.

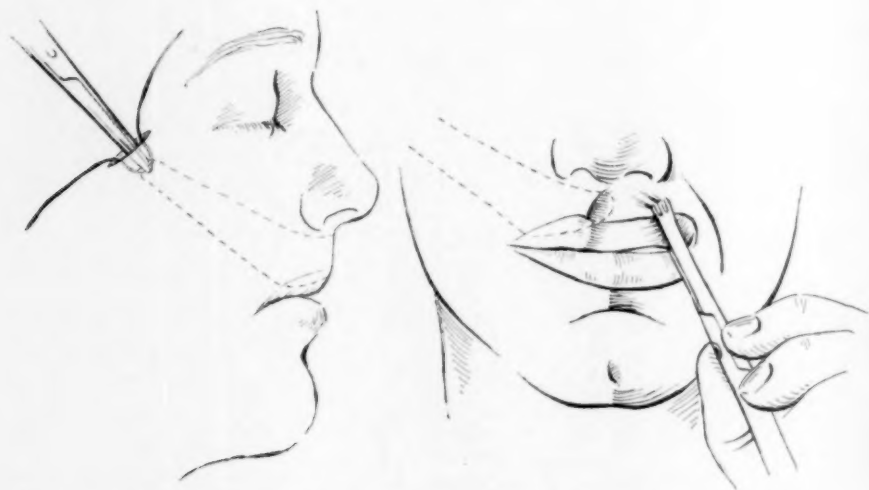


FIG. 7.—The knot is grasped with a mouse-toothed mosquito forceps and, with the Jacobs forceps in the lip, is drawn upon in the reverse direction to see that the knotted loop maintains the over-correction. If this test proves satisfactory, the tension on the Jacobs forceps is released, and the knot still held in the jaws of the mouse-toothed forceps is withdrawn from the skin incision.

TENDON STRIPS IN FACIAL PARALYSIS

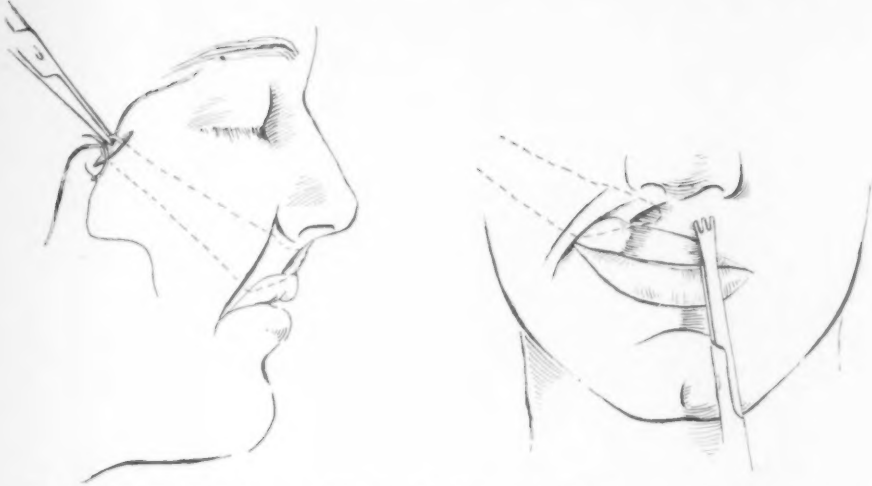


FIG. 8.—The knot is fixed with a few fine silk sutures before the forceps are removed, and then dropped back in the wound. The fixation is again tested by gentle traction on the Jacobs forceps.

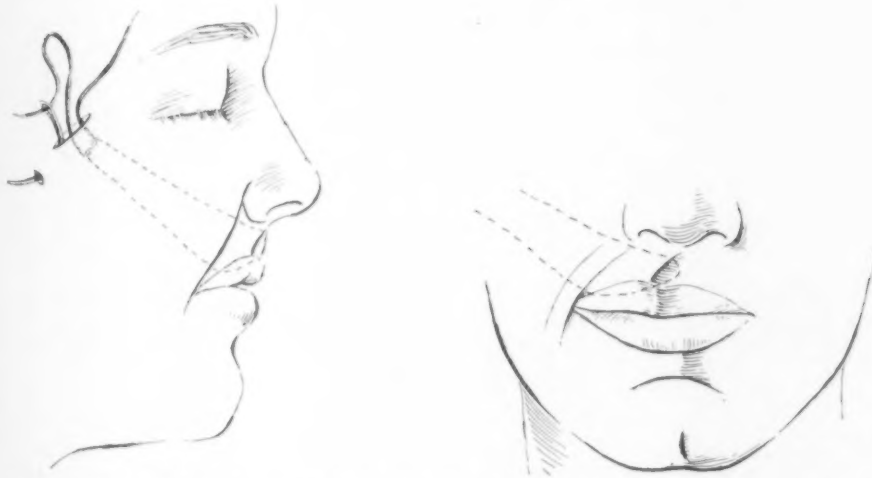


FIG. 9.—The free ends are buried by drawing them into the face tissues with a Reverdin or a large-eyed surgical needle, and the incision closed with a horse-hair suture.

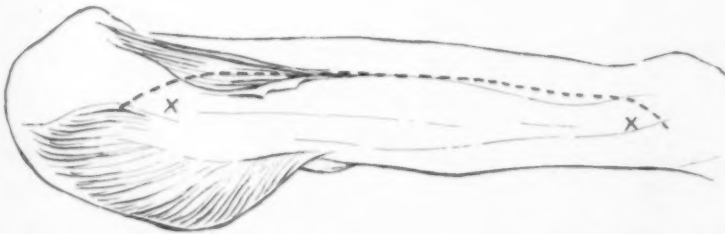


FIG. 10.—Lateral view of the fascia of the thigh. The dotted line shows position of the skin incision down to the ilio-tibia band. It is from between the two XX's that the longest strip can be obtained. The upper X is situated between the posterior border of the tensor-fascia femoris muscle and the greater trochanter of the femur. We try to get these fascia strips fifteen to eighteen inches long and less than an eighth of an inch wide, and they should be cut in the line of and not across the fibres of the ilio-tibia band.

ENTEROANASTOMOSIS IN INTESTINAL OBSTRUCTION

By JOHN WALTER VAUGHAN, M.D.

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SO VOLUMINOUS is the literature upon the subject of intestinal obstruction that it is approached with much hesitancy. However, after a rather comprehensive review of the cases which have come under the attention of the writer during the past few years, certain observations have resulted which, while probably adding nothing new to the handling of this distressing condition, yet have not been sufficiently stressed to render their importance impressive.

By intestinal obstruction is meant a more or less complete blocking of the intestinal tract at any level between the duodenum and the anus. When the block is in the jejunum or upper ileum it is customary to designate the condition as "high obstruction," while the term "low obstruction" is employed when the lower ileum is involved. The latter term is also used when the obstruction is located in any portion of the large bowel.

Such a division is entirely arbitrary and of but little value except that it has been observed that high obstruction is usually more rapidly fatal than low obstruction. This has been explained because of a belief that the toxins developed in the intestine are more virulent in the higher portions. It is a demonstrated fact that any protein can primarily be split up into a very toxic and a non-toxic substance, and that these must be reduced to far simpler substances before being available for absorption, which, however, is not proof that the poison radical is ever absorbed as such.

That starvation is more rapid and complete in high obstruction than in low, is easily understood when we stop to refresh our memories concerning the normal physiological functions of the different intestinal levels.

Metabolism of carbohydrates begins through the catalytic action of ptyalin found in the saliva. This splits starch into maltose and glucose. This carbohydrate digestion begins in the mouth and is continued in the stomach until finally inhibited because of an excess of hydrochloric acid. It is again resumed in the small intestine through the action of the amylase of the pancreatic juice. Here the enzyme invertase converts cane sugar into lævulose and glucose. Fats are not digested appreciably until they have reached the duodenum, where the pancreatic juice and bile split them into fatty acids and glycerins. While the carbohydrates after proper preparation pass into the portal system, the fats are taken up into the lacteals of the intestinal villi and then into the thoracic duct, thus short-circuiting the liver. Proteins, which are essential constituents of all living tissue, are digested first in the stomach through the action of pepsin and hydrochloric acid. Here digestion progresses only to the peptone stage, after which it passes into the intestine. Here

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trypsin and the alkali content continue digestion until polypeptides and amino-acids result, in which form they can be utilized.

From this brief review it can be seen that but little food value can be obtained from either carbohydrate, fat or protein until these substances have passed a considerable distance along the course of the small intestine from which it can be deduced that starvation is more rapid and complete the higher the obstruction. Of at least equal importance is the function of the large intestine in maintaining a water balance through its power of absorbing water from its content. Any interference which causes complete loss of this function means rapid dehydration and death. We know that a comparatively small portion of large bowel can carry out this process satisfactorily, but a small amount of active large intestine is essential. Temporarily dehydration can be partially prevented by the subcutaneous and intravenous administration of fluids, but the water balance cannot be maintained in this manner indefinitely. That this matter is one of extreme importance can be shown by a review of certain cases, and the results obtained where this function has been maintained through the use of enteroanastomosis in preference to enterostomy.

In the presentation of the following cases only the briefest mention of essential points is made. Complete laboratory and clinical records are available, but a detailed report of each case would only be wearisome and add nothing to the conclusions deduced.

CASE No. 3481.—S. A., March 9, 1925, a hysterectomy had been performed because of a large fibroid jammed in the pelvis. The appendix was also removed. All raw surfaces were well peritonized. Vomiting persisted after operation and March 13 it was decided that intestinal obstruction had resulted. The old incision was opened. The small intestine was markedly distended and of a bluish color. It was adherent to the lower angle of the wound, which apparently was the cause of the obstruction. This was separated and an enterostomy performed above this point. Decided improvement was noted for three days, after which obstructive symptoms again recurred. March 18 a high enterostomy about six inches below Treitz's ligament was made. Again there was decided improvement. The pulse rate was lowered from twenty to thirty beats per minute and vomiting ceased. Flatus and fecal matter were passed by rectum. Improvement continued until the twenty-third when the enterostomy tube became loose, wound infection resulting. Rapidly the patient's condition became worse and death occurred upon the twenty-fifth, twelve days after the last enterostomy.

Impression.—In spite of the copious subcutaneous administration of saline and the intravenous injection of hypertonic salt, the patient became rapidly dehydrated and succumbed because of an infection which ordinarily would have been considered as slight.

CASE No. 2668.—Mrs. S. W. entered the Detroit Diagnostic Hospital suffering from intestinal obstruction of two days' duration. There had been no previous abdominal operation. Operation December 6, 1926, showed about 200 cubic centimetres of serous fluid in the abdominal cavity. The small bowel was distended, but not discolored. A Meckel's diverticulum, three-quarters inch in length, was encountered, but not disturbed as the obstruction was farther down near the ileocecal valve. At this point the small intestine was encircled by a small strip of omentum, which caused almost complete constriction. Cutting of this band relieved the obstruction, the small bowel immediately filling to the cæcum. In spite of the apparently favorable findings and the slight manipulation, the patient continued vomiting. December 8 low enterostomy was performed. This was followed by improvement lasting three days, after which obstructive

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symptoms again developed. December 13 a high enterostomy was made. Vomiting ceased and improvement was marked until the enterostomy tubes loosened. Again wound infection resulted and December 21 the patient succumbed.

Impressions.—Again death resulted from a comparatively slight infection after the loosening of the enterostomy tubes, as well as the observation that low enterostomy is sometimes followed by a plastic peritonitis, which results in a second obstruction above the point of enterostomy. This observation has been mentioned by others and observed many other times by the writer.

CASE No. 193.—Mr. H. F. entered the hospital August 13, 1923, with signs of intestinal obstruction. There had been no previous operation. Upon opening the abdomen there was considerable free fluid and the small bowel was markedly dilated. There were several small hæmorrhagic areas in the bowel. The obstruction was evidently the result of adhesions resulting from a chronic appendix, which involved both intestine and omentum. These were separated and the appendix was removed. Vomiting continued and the obstructive signs were not relieved. August 19 a high enterostomy was performed, which disclosed a new obstruction resulting from the plastic peritonitis present. Death occurred suddenly a few hours later, the immediate cause probably being the aspiration of vomitus.

Impression.—This represents another case in which a second higher obstruction followed the plastic peritonitis resulting from the first.

CASE No. 11.—A. L. had previously been operated upon for the removal of an acute purulent appendix. April 26, 1923, he entered the hospital with symptoms of intestinal obstruction. Operation proved this to be true, the omentum being adherent to both intestine and parietal peritoneum so as to cause three distinct obstructive points in the terminal foot of ileum. Adhesions were freed and the omentum resected. Recovery, which was uneventful, was followed one month later by the recurrence of obstructive symptoms. These became more pronounced and then again complete. September 19 the abdomen was again opened, and it was found that the terminal three feet of small intestine were so matted that resection was thought advisable. The patient progressed favorably until September 23, when vomiting, which soon became fecal, recommenced. At this time an enterostomy above the point of resection was made. Improvement was again noted until the enterostomy tube was removed. This was followed by slight wound infection, which resulted in death October 13.

Impression.—An enteroanastomosis sidetracking the obstruction, performed at the first operation, would probably have resulted differently. A subsequent case will illustrate this point.

CASE No. 4013.—H. C. was relieved of an acute purulent appendix October 13, 1928. Five days later, signs of obstruction developed. October 19 the wound was reopened and adhesions were observed, which had caused a twisting of the small intestine near the ileocecal valve, the bowel being markedly dilated above this point. The adhesions were separated and an enterostomy performed above the obstructive point. This was followed by the relief of symptoms for a period of three days after which they recurred. October 25, a high enterostomy was performed, which revealed a higher obstruction due to plastic peritonitis. The patient showed decided improvement and took nourishment well. After removal of the enterostomy tube he began to fail, and died November 1.

Impressions.—Here again is a case in which enterostomy was followed by a second higher obstruction due to plastic peritonitis. In spite of the use of hypodermoclysis and hypertonic saline, as well as numerous blood transfusions, the patient became much dehydrated and succumbed following slight wound infection.

CASE No. 1159.—M. G. had been operated upon December 30, 1924, because of an acute purulent appendicitis. January 20, 1925, she entered the Detroit Diagnostic Hospital because of intestinal obstruction. At this time adhesions were separated.

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March 25, 1925, the patient returned because of definite recurrent obstruction. The small bowel was obstructed as well as the transverse colon, which was involved in the adherent mass. Again the adhesions were separated and the omentum so placed and sutured as to aid in the prevention of recurrence. May 25, 1925, the patient re-entered the hospital with complete obstruction, which was located in the ileum one foot from the cæcum. At this time a lateral anastomosis was made between the ileum above the obstructed point and the mid-portion of the transverse colon. The patient left the hospital June 11, feeling much improved. July 7, 1925, she again entered the hospital because of obstruction. At this time it was found that the anastomosis was closed because of adhesions and a second anastomosis was made four inches proximal to the previous one. She left the hospital July 24 apparently relieved. November 16, 1925, symptoms of obstruction having recurred, adhesions between the abdominal wall, omentum and the anastomosis were separated.

February 4, 1926, obstruction recurred. The abdomen was opened and an anastomosis was made between the upper sigmoid and ileum, thus widely sidetracking the adherent mass. After this, symptoms were much improved, except for violent and almost continuous headaches. March 11, 1926, a resection of bowel beginning at the small intestine distal to the last anastomosis was made. This was performed in two stages, the first operation consisting in simply dividing the small intestine and inverting the end near the anastomosis, while the distal end of the small bowel was brought out through the wound. The second stage was accomplished April 15, 1926, when the free end of small intestine, the cæcum, ascending and transverse colon were removed. The patient was free from trouble until September 27, 1926, when vomiting recurred. In October this was again observed and at this time the patient insisted that the vomiting was associated with menstruation. Radiographs showed no obstruction.

January 22, 1929, definite obstructive signs recurred and the abdomen was opened once again. The small intestine was found adherent to the abdominal wall about two feet above the anastomosis. The lumen was almost obliterated and the bowel was torn in the attempt to free it. Resection of three inches and end-to-end anastomosis were done. At this time it was observed that the abdomen was remarkably free from adhesions. Since this time the patient has remained perfectly well and has gained many pounds in weight.

Impressions.—Clinically, this patient improved much more rapidly after entero-anastomosis than any case ever had after enterostomy. Convalescent dehydration was not observed, even though her primary condition was much worse than in cases where death had resulted after simple enterostomy.

CASE NO. 3379.—G. B. had been operated upon December 12, 1927, because of an acute retrocecal appendicitis. The appendix was ten inches long and very adherent. The wound had become infected. June 9, 1928, he suffered an attack of vomiting, which lasted two days. October 28, 1928, he entered the hospital after four days of vomiting, which had become fecal in character. On opening the abdomen free fluid was present and the small intestine was greatly distended and spotted with hemorrhagic areas. An omental band was found which caused low intestinal occlusion. This was severed and an enterostomy made above the obstructed point. The condition of the patient improved gradually until November 20, when fecal vomiting again recurred. The abdomen was opened and a second obstruction found one foot above the enterostomy. Two feet of intestine were resected and an end-to-end anastomosis made. However, fecal vomiting continued and the patient became rapidly worse. November 23 a high right rectus incision was made and the small intestine above the previously obstructed point was anastomosed to the colon at the hepatic flexure. The opening was about two and one-half inches. Vomiting ceased and recovery progressed uneventfully. The patient has since claimed excellent health, although there is present a fascia separation, which requires the use of a belt.

Impressions.—This is probably the most advanced case of intestinal obstruction that I have ever seen recover, and it would seem that the enteroanastomosis and early reestablishment of water balance played an important part in the result.

CASE NO. 2111.—E. P. had been operated upon for the removal of the appendix about two years previously. This operation had been performed in an eastern hospital and no record of the condition found was available. He entered the hospital April 2, 1926, because of intestinal obstruction of two days' duration. Operation disclosed adhesions between omentum and terminal ileum one inch from the ileocecal valve to be responsible. These were separated and the omentum resected. Recovery was stormy for three days, then uneventful.

December 21, 1928, the patient again entered the hospital because of intestinal obstruction. The small intestine was found to be glued into an obstructive mass for a distance of six inches from the ileocecal valve. The adhesions were separated, leaving much raw surface on the intestine. Fearing a rapid recurrence, an ileocecostomy was performed, sidetracking the denuded area. Recovery was uneventful, and the patient has remained well since.

The above case is representative of two similar ones in which similar results were obtained.

CASE NO. 4365.—M. R. had been operated upon April 22, 1929, for the removal of a large impacted fibroid. In September of the same year she was seen because of a partial intestinal obstruction, which relieved itself. Symptoms, however, recurred and October 12, 1929, the abdomen was opened because of complete obstruction. A considerable portion of small intestine was adherent in the pelvis. While attempting to free these adhesions the intestine was badly torn. The tear was closed with a double layer of sutures and a lateral anastomosis made between small intestine at a point above the obstruction and the transverse colon. The patient showed rapid improvement, but still suffered from recurring attacks of abdominal pain and vomiting. December 19 the second stage of the operation was performed. This consisted in the removal of the small intestine from the point of anastomosis to the cæcum, which was adherent in the pelvis. This portion was nine feet long and many obstructive points were encountered forming dilated bowel areas filled with fecal matter and pus. So adherent and friable was the bowel that its lumen was opened three times during the dissection. The end of the small bowel near the anastomosis was inverted, while a short portion left to the cæcum was attached to the lower angle of the wound, the patient's condition making inadvisable the removal of the useless portion of large intestine at that time.

Parenthetically, resulting observations have been of interest. As long as the patient was confined to bed all bowel movements occurred normally, even though radiographic examination showed a filling of the inactive portion of the large intestine after a barium meal. However, as soon as the patient assumed an upright position and began to walk, gravity played a more important part, and fecal matter was occasionally discharged through the cecal fistula.

Another interesting observation was that the shortening of the small intestine has so interfered with the digestion of some foods that they always appear in recognizable form when eaten. Other foods are completely digested, thus showing that digestion of certain foods occurs simultaneously with absorption of others at certain intestinal levels. Further observations are contemplated.

At present this patient is in excellent health, eating well of a regulated diet and having gained many pounds.

CASE NO. 1319.—M. L. This case is mentioned simply because it is one of several and represents a type. The only unusual thing about the case is the patient's age, which was eighty-three when she was first seen, with complete obstruction of two days' duration, due to a carcinoma at the junction of the rectum and sigmoid. Colostomy was performed six inches above the tumor. The patient lived five years in comfort, dying but a week ago from a coronary thrombosis.

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The mortality rate in cases of intestinal obstruction treated by enterostomy has been approximately 40 per cent. In contra-distinction to this our records show six cases of low small intestinal obstruction treated by enteroanastomosis without a fatality, many of which were much further advanced than some which proved fatal after treatment by enterostomy.

In conclusion, I would state that the factor of water balance is of decided importance. Subcutaneous and intravenous administration of fluids aids decidedly and the use of hypertonic saline is of extreme value; yet, in spite of all these aids, dehydration eventually occurs unless the physiological action of the large bowel is re-instated.

By preference we now treat high obstruction, which is rare, by means of enterostomy and relief of the obstruction, the enterostomy being closed at the first manifest improvement in the patient's condition.

Low obstruction, including the transverse colon, is preferably handled by sidetracking the obstruction through enteroanastomosis, subsequent resection being done when indicated, and obstruction below this point is best cared for by means of colostomy.

DISCUSSION: DR. THOMAS G. ORR, of Kansas City, Mo., remarked as to the poor results obtained by simple high enterostomy, that it is a fairly well-known fact that in experimental animals, if the upper jejunum is drained death results in a few days. He had run a series of experiments in animals doing a simple jejunostomy and in a second series obstructing the gut and doing a jejunostomy as a part of the treatment. The animals died much more quickly with a simple jejunostomy than they did if they obstructed and waited for a few days before doing the jejunostomy. In other words, he thought with a jejunostomy the animals died much quicker than with the simple obstruction.

The cause of death in intestinal obstruction is still undecided. He was very suspicious, however, that the loss of the upper intestinal tract secretions is much more important than the question of any absorption of toxin from the obstructed gut.

While the administration of sodium chloride and water will unquestionably prolong life in intestinal obstruction, there is another element in the disease which is not replaced by this treatment. The loss of other secretions into the gut above, especially the pancreatic secretions, appear to be important. Jejunostomy should be used with a good deal of care, because of this particular danger. Professor Wilkie discussed this last year and showed very definitely that by draining the upper jejunum into the gut below that he was able to save patients.

Dr. Rader of Omaha has treated a number of patients in which he anastomosed the ileum to the sigmoid with success, thereby avoiding the extensive external drainage of the upper intestine. Loss of upper gut secretions is very intimately bound up with the question of the cause of death, and deserves considerable study. I believe that too much emphasis has been placed upon jejunostomy as a treatment in acute intestinal obstruction.

SECTION OF THE SYMPATHETIC NERVES OF THE DISTAL PART OF THE COLON AND THE RECTUM IN THE TREATMENT OF HIRSCHSPRUNG'S DISEASE AND CERTAIN TYPES OF CONSTIPATION

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IT APPEARS to be established that interruption of the sympathetic nerve supply to the large bowel is of benefit in selected cases of idiopathic dilatation of the colon. Hitherto, such interference has been either lumbar gangli-

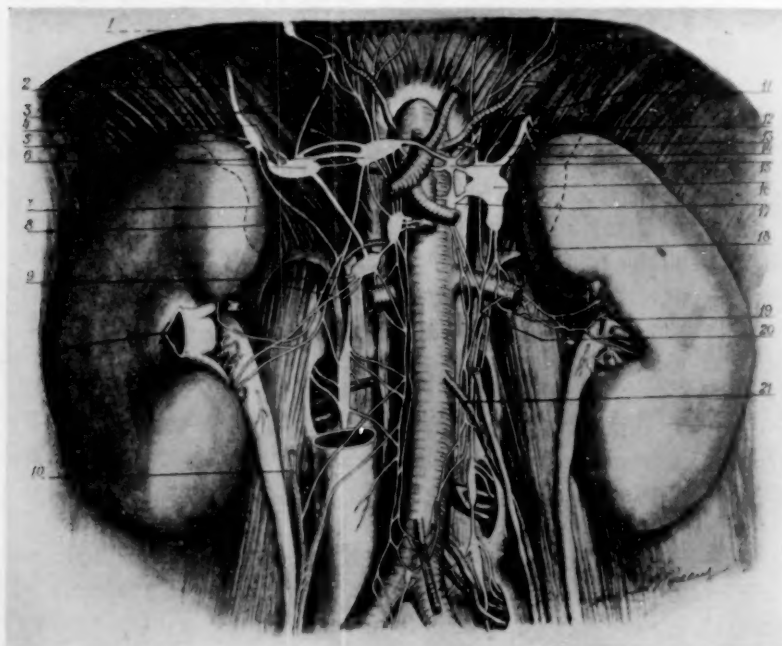


FIG. 1.—The formation of the intermesenteric plexuses: Branches from the semilunar ganglia (6 and 16), the celiac ganglion, and the renal periarterial plexuses (20) form two or more intercommunicating trunks on each anterolateral aspect of the aorta; branches from the second lumbar ganglion join the trunks on the right side. The roots of the inferior mesenteric nerves arise from the intermesenteric plexuses. (Taken from Hovelacque.)

nectomy and ramisectomy, in which the second, third and fourth lumbar ganglia, with their connecting trunks and communicating branches, have been removed on both sides,⁵ or an operation on the left side,¹¹ in which "the white ramus from the first lumbar nerve to the first lumbar ganglion and, if there was a large branch from the second nerve to the second ganglion, this also was divided. All the branches (usually four) leaving the

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ganglion on the medial side, and one from the first and second ganglia, and one or two smaller ones from the fourth have been severed and the cord has been cut across below the fourth ganglion."¹⁰ As a result of closer

study of the anatomy and physiology of the nerves passing to the distal part of the large bowel, it has been possible to simplify the operation so that the nerve section is limited to the actual fibres supplying the intestine; only this procedure insures the interruption of all the fibres reaching the distal part of the colon from the thoracolumbar sympathetic outflow. The operation has also been applied in a case of obstipation in which the cause of difficulty was lack of tonus in the rectum.

*Anatomy of the sympathetic nerve supply to the distal part of the colon and to the rectum.*⁴—The sympathetic nerves which pass to the distal part of the colon have for their immediate origin the intermesenteric plexuses (Fig. 1). These networks of nerves descend on the anterolateral aspects of the abdominal aorta, from the level of the origin of the superior mesenteric artery downward. On each side there are two or three large trunks, which are made up of nonmyelinated fibres, arising from: (1) the semilunar ganglion and celiac plexus; (2) an anastomotic loop which crosses the aorta transversely, below the origin of the superior mesenteric artery; and (3) the aorticorenal ganglion, or the renal

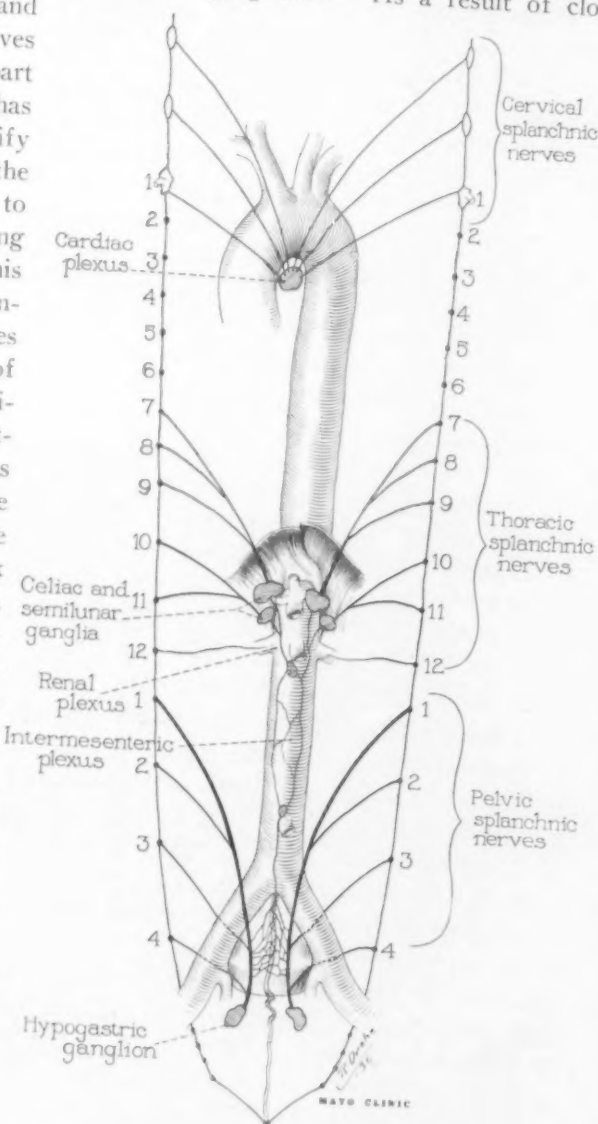


FIG. 2.—Delmas' conception of the distribution of the sympathetic system. The pelvic splanchnic nerves, derived from the four lumbar sympathetic ganglia, supply only pelvic viscera. This may be compared with Figure 1, in which branches from the lumbar ganglia are shown joining the intermesenteric plexuses. (Redrawn from Delmas.)

The intermesenteric plexus is joined on each side by branches from the first and second lumbar ganglia. These branches contain myelinated fibres; those on the right side pass between the vena cava and the aorta to reach the front of the latter vessel. The fibres which form the intermesenteric plexuses are thus derived from two sources: their original fibres spring from that part of the abdominal sympathetic system connected with the thoracic splanchnic nerves, while the branches which the plexus receives as it descends along the aorta spring from the lumbar ganglia or trunks. There is a difference of opinion among anatomists concerning the extent to which the lumbar fibres mingle with those of the intermesenteric plexus proper. According to Delmas, Laux, and others, the mesially-directed lumbar communicating branches, constituting the pelvic splanchnic nerves, remain distinct in the outer part of the plexus (Fig. 2), and ultimately form the lateral roots of the presacral nerve of Latarjet (superior hypogastric plexus of Hovelacque). On the other hand, Hovelacque holds that these lumbar communicating branches actually contribute to the intermesenteric plexus (Fig. 1). The point is one of great significance. If the former view were correct, lumbar ramisectomy and ganglionectomy would affect only that portion of the bowel innervated through the presacral nerve; namely, the lower part of the rectum and the internal sphincter of the anus; if the latter arrangement were the true one, it would affect, but only partly, the descending and sigmoid portions of the colon,* as well as the rectum and the internal sphincter of the anus. The beneficial results of lumbar ramisectomy in cases of Hirschsprung's disease strongly favor the view that the branches which join the intermesenteric plexus from the first and second lumbar ganglia do have a share in the innervation of the colon.

Immediately below the level of the origin of the inferior mesenteric artery, a large branch leaves the intermesenteric plexus of each side, and passes inward, on the aorta, to reach the inferior mesenteric artery about 1.5 centimetres from its origin (Fig. 3). Finally these two trunks unite, and give rise to three or four large branches which course along the lateral borders of the vessel, communicating at intervals with each other. Fortunately for the surgeon, the nerves associated with the inferior mesenteric artery retain their individuality, and neither form so close a network, nor possess such an intimate relationship with the wall of the vessel, as do the nerves supplying other viscera. From these nerves subsidiary trunks arise at the levels of the main divisions of the artery. Soon, however, they abandon the vessels, and anastomose with one another in avascular parts of the mesosigmoid. From this network the final nerves of distribution are derived; these slender filaments cross the juxtacolic vascular arcades, and enter the wall of the bowel between the terminal branches of the vessels. Two or three large branches accompany the superior hæmorrhoidal artery, and invest the lateral and posterior walls of the rectum in a plexiform manner. Their

* In the dog, there is no doubt that the communicating branches from the lumbar ganglia play an active part in the innervation of the colon.*

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terminal twigs join the hypogastric ganglia. The distribution of the inferior mesenteric nerves corresponds to that of the inferior mesenteric artery, and toward the end of the transverse colon, where the left colic artery anastomoses with the middle colic, branches of the inferior mesenteric plexus communicate with filaments derived from the superior mesenteric plexus.

It has been seen that the inferior mesenteric nerves are formed in greater part of post-ganglionic fibres. If the lumbar communicating branches contribute to the plexus, there should be a ganglion about the root of the artery, in which their myelinated fibres effect synapses. There is no doubt that there are ganglionic masses in this area, but they are most inconstant, both

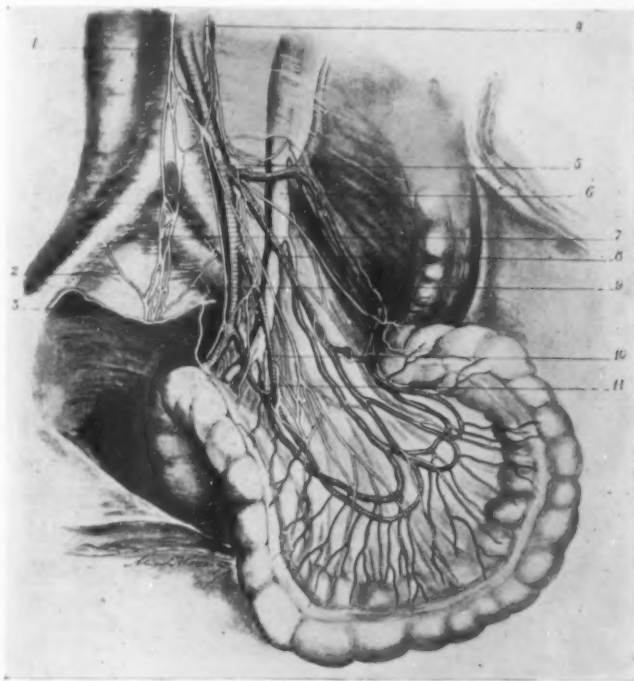


FIG. 3.—The inferior mesenteric nerves: 1, intermesenteric nerves of right side; 2, branch from right fourth lumbar ganglion to presacral nerve; 3, cut edge of peritoneum; 4 intermesenteric nerves of left side; 5, inferior mesenteric nerves; 6, inferior mesenteric vein; 7, presacral nerve; 8, sigmoid artery; 9, branch from left fourth lumbar ganglion to presacral nerve; 10, sigmoid artery, and 11, sigmoid artery. (Taken from Hovelacque.)

in position and in size. In the foetus and in the child, a ganglion is present at the root of the artery,³ where it has been identified in serial sections of embryos at the sixth week of gestation. As development proceeds, and new neuronic connections are established, the ganglion becomes less demarcated. When present it is most often found below the origin of the artery,⁴ at the juncture of the two parts of the intermesenteric plexus, after they have given off the nerves to the colon; that is, apparently only indirectly connected with the inferior mesenteric nerves.

Anatomy of the sympathetic nerve supply to the rectum and to the internal sphincter of the anus.—In some cases of Hirschsprung's disease the

dilatation of the large bowel extends to the internal sphincter of the anus, so that it has been suggested that this structure may offer undue resistance to the expulsion of the contents of the bowel. In vertebrates the internal sphincter of the anus is innervated through the thoracolumbar sympathetic outflow.² In man, there are two possible paths by which thoracolumbar fibres might reach the sphincter: (1) by way of the inferior mesenteric nerves, their superior hæmorrhoidal branches, and the branches of distribution of the hypogastric ganglia; and (2) by way of the presacral nerve (superior hypogastric plexus), and the branches of distribution of the hypogastric ganglia.* The first route has been described. The presacral nerve is a complex nerve, lying in the angle between the common iliac arteries. It has three roots.⁷ On each side, succeeding branches arising from the first to the fourth lumbar ganglia join to form its lateral roots, which converge toward the anterior aspect of the fifth lumbar vertebra. Into the angle between the two lateral roots descends the third or middle root, which consists of the terminal part of the intermesenteric plexus. In 20 per cent. of cases the presacral nerve is single; in the remaining 80 per cent. the three roots form a more or less intricate plexus between the common iliac arteries. The nerve descends into the pelvis, and at the level of the first sacral vertebra divides into the two hypogastric nerves, which join the corresponding hypogastric ganglia. From these, post-ganglionic fibres of distribution pass to the pelvic viscera, including the lower part of the rectum and the internal sphincter of the anus.

Physiology of sympathetic nerve supply to the distal part of the colon, the rectum, and the internal sphincter of the anus.—It is generally accepted that the fibres of the inferior mesenteric plexus which end in the musculature of the colon and rectum carry impulses which inhibit its activity. Further, it would appear probable that these nerves keep up a continuous influence on the tonus of this portion of the bowel; in the dog, section of the corresponding nerves always leads to an immediate increase in intracolonic pressure.⁹ With regard to control of the internal sphincter of the anus, it has been found in experimental animals,⁸ and in man (Case II), that the thoracolumbar outflow provides the motor supply for this muscle.

The basis of the suggested operation—In Hirschsprung's disease.—We do not wish to make a critical examination of the numerous suggestions which have been offered as the cause of idiopathic dilatation of the colon; in our opinion that of neuromuscular dysfunction seems most reasonable in a large number of cases. Rather, we shall consider the essential pathologic anatomy of the lesion. The colon is dilated, and the dilatation is most marked in its distal part, sometimes reaching the internal sphincter of the anus. Although the muscular coat is hypertrophied, it is unable to transmit the content of the intestine. Even if, in our ignorance of its ultimate cause,

* In the dog, fibres reach the sphincter by way of both the hypogastric nerves (which are homologous with the presacral nerve) and the inferior mesenteric nerves.⁸

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we cannot attack the disease directly, we may still carry out flanking attacks in three directions: (1) we may attempt to diminish the dilatation of the colon; (2) we may try to leave its motor nerves in less disputed control; and (3) we may attempt to relieve any opposition to the expulsion of the content of the bowel offered by the internal sphincter of the anus. If our anatomic and physiologic reasoning is correct, we can accomplish the first and the second objects by division of the inferior mesenteric nerves, and the third by division of the presacral nerve.

Next it must be inquired if these operations can be performed without endangering the functions of any viscera, by interrupting important efferent or afferent fibres. In particular, it is essential to safeguard the afferent fibres from the ampulla of the rectum, so that the mechanism for defecation may be set in motion when fecal matter enters that part of the bowel. In the dog, division of the inferior mesenteric nerves results only in increase in the tonus of the distal part of the colon, and in the patients on whom we performed this operation, the only discernible effect on the colon was the desired one. With regard to the presacral nerve, there is abundant evidence of its functions in man; it is an important afferent path for painful impulses, particularly from the female genitalia and from the bladder; it probably contains inhibitory fibres for the musculature of the bladder, but only rarely, after its section, is transient frequency of micturition observed, and it supplies motor fibres to the internal sphincter of the anus (Case II). The afferent fibres concerned in reflex defecation pass to the spinal cord largely if not entirely by way of the pelvic nerves and the second, third and fourth sacral posterior roots; they are preserved in the suggested operation, which may be performed without fear of producing undesirable results.

In certain cases of obstipation.—When Röntgenograms after a barium meal have given evidence that the faeces reach the distal part of the colon or the rectum in a normal time, it is reasonable to establish the underlying pathologic condition as being in that part of the large bowel. However, the pathologic anatomy in such cases differs from that in Hirschsprung's disease; the rectum may be unduly dilated, but the dilatation is not accompanied by hypertrophy of the muscular coat; indeed, in long-standing cases the muscular coat is actually atrophied. The underlying factor is probably a gradual raising of the threshold of the rectal sensory nerves to the presence of faeces in the ampulla, due to long-continued deliberate neglect to answer the call to defecation. We believe that the operation should be considered in such cases, on the hypothesis that interruption of the inhibitory nerves to the rectum may permit a readier response of the rectal musculature to such reflex stimuli as reach the intramural plexuses.

Technic of operation.—Since the inferior mesenteric artery arises opposite the third lumbar vertebra, and the presacral nerve is to be found in front of the fifth lumbar vertebra, full exposure of these structures may be obtained through a left paramedian incision 15 centimetres long, and centered on the umbilicus. A self-retaining retractor is adjusted, and the table is

tilted to the Trendelenburg position. The small bowel is packed off upward and to the right, so as to expose and pull upward the root of its mesentery; the attachment of the mesentery to the posterior abdominal wall is above the field of the operation, save when the bifurcation of the abdominal aorta is unusually high. An assistant draws the sigmoid colon to the left and slightly downward, to expose the bifurcation of the aorta. In rare cases, the root of the mesosigmoid may be displaced medially, in front of the fifth lumbar vertebra, when it must be mobilized by division of the right leaf of its peritoneum. The promontory of the sacrum is now identified, and in most cases it is possible to see the strands of the presacral nerve as they descend

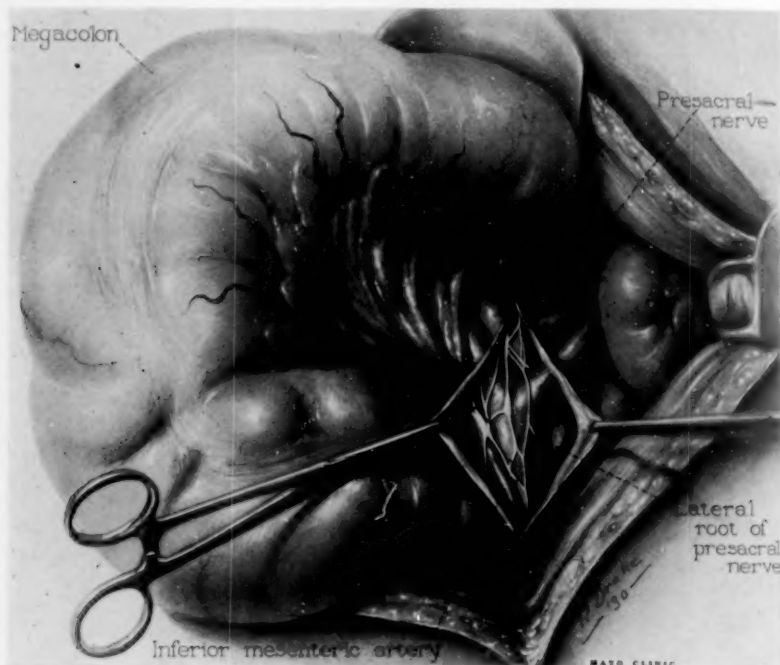


FIG. 4.—(Case I). The field of operation. After division of the presacral nerve, the inferior mesenteric nerves were removed by dividing them at the points indicated.

in the middle line, immediately under the peritoneum. The peritoneum is picked up in the middle line, and is incised vertically from the level of the promontory to the origin of the inferior mesenteric artery (Fig. 4). The two edges of this incision are displaced by forceps to each side. The strands of the presacral nerve are not adherent to the membrane, and posteriorly they are separated from the great vessels by a layer of fine connective tissue. The nerve is first divided below, at the right border of the left common iliac vein; it is well to place a ligature on its distal end, as this is usually accompanied by a small artery. It is then raised upward by gentle dissection with cotton pledgets, and the branches which reach it from the fourth lumbar ganglia are divided on each side. Immediately below the bifurcation of the aorta, the connecting branches from the third lumbar ganglia are divided

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as they pass to join the nerve from beneath the common iliac arteries. When the nerve has been raised a little higher, its lateral roots, formed by the union of branches from the first and second lumbar ganglia, may be severed; the middle root is preserved if possible, to be used as a guide to the intermesenteric plexus. The trunk of the inferior mesenteric artery is now identified; by tracing upward the middle root of the presacral nerve the operator reaches the two large principal roots of the inferior mesenteric plexus, one on each side of the vessel, and joining it 1.5 centimetres below its origin. If the middle root of the presacral nerve cannot be used as a guide, the main trunks of the inferior mesenteric plexus will be found at the positions of five o'clock and seven o'clock with reference to the origin of the artery. They are large and easily isolated. About 2.5 centimetres of each are then resected; if any ganglionic mass is present on either, it must be included in the resected portion. Any subsidiary periarterial strands are then sought for and, if any are found, they are divided. Bleeding is not to be expected during this part of the operation. The inferior mesenteric vein is too far to the left to appear in the field. The incision in the posterior peritoneum is now brought together with a continuous suture of catgut, and the abdominal wound is closed in the usual manner.

REPORT OF CASES

CASE I.—*Hirschsprung's disease.* A youth, aged seventeen years, came to The Mayo Clinic, August 15, 1929, complaining of constipation, with fecal impaction. He had been constipated since birth, but in the last four or five years fecal impaction had become more frequent, in spite of the use of diets, laxatives, and oil enemas. Examination revealed a hard, freely movable mass of feces, about 8 centimetres in diameter, to the left of the middle line of the abdomen, and beyond the reach of a finger in the rectum. Röntgenograms after a barium meal gave evidence of an enormously dilated colon, the dilatation extending to the internal sphincter of the anus. Otherwise the findings on examination were essentially negative.

After a period of three weeks, during which the patient was kept on a diet free from residue, had daily instillation enemas of mineral oil, and took mineral oil by mouth three times a day, the colon was emptied of feces, and laparotomy could be undertaken.

Operation was performed September 3, 1929. The transverse colon, sigmoid colon, and rectum were hugely dilated. The ascending colon and cæcum were less dilated, although there was evidence of the disease in the appendix, which had the girth of a fifth finger. The appendix was removed in the usual way.

The peritoneum over the front of the fifth lumbar vertebra was then opened, and the presacral nerve, in this case single, was easily identified; about 5 centimetres of it were removed. The origin of the inferior mesenteric artery was then exposed by continuing upward the incision in the posterior peritoneum. A number of smaller nerve bundles passing along the artery were first identified and divided. Finally a large nerve bundle was picked up at the position of seven o'clock, and two smaller bundles respectively at five o'clock and ten o'clock. A portion of each strand was resected. The incision in the posterior peritoneum was then closed by a continuous suture of catgut, and the abdominal wound was sutured in layers.

We were sanguine of the success of the operation from the first, as there was entire absence of any gaseous distention of the colon such as might have been expected after operation in such circumstances. Eight days after operation, there was recurrence of fecal impaction, which yielded to enemas of 50 per cent. peroxide of hydrogen. Three

weeks after operation the bowels were moving well, and all medication was stopped save mineral oil by mouth.

One month after operation the patient was dismissed. He was to take a generous anticonstipation diet, and to use instillations of oil into the rectum, if these should be required. Two months after the operation he wrote to say that he was in excellent health, and that only once since his dismissal had an oil enema been necessary. A month later came a further excellent report: "My bowels move once or twice every day and I take only an ounce of mineral oil about every other day." Seven months after the operation the patient wrote: "I am feeling fine. I have a good appetite, and my bowels move on the average twice a day. I am not taking any medicine, except, occasionally, some mineral oil."

CASE II.—*Rectal type of obstipation.* A waitress, aged twenty-three years, had been under observation for a year, on account of obstinate constipation with episodes resembling acute intestinal obstruction. Three years previously she had had an abdominal operation elsewhere, when a hairpin had been removed from the lower portion of the ileum. Since this operation, she had had increasing difficulty in moving her bowels, and every two or three weeks she had been constipated for two or three days. One year previously she had undergone röntgenologic study of her alimentary tract at The Mayo Clinic, when the following report had been made: "After three hours the stomach contains a little barium. The remainder is in the terminal ileum and in upper loops of the jejunum. After six hours the stomach is empty and almost all the barium is in the cæcum. After twenty-eight hours all the barium is in the right half of the colon. After fifty-four hours the head of the column is in the pelvic colon. There is no slowing in the small bowel, and there is considerable slowing, but no definite point of obstruction, in the large bowel."

A few days after this report had been made, obstruction had occurred again. After six days, during which a little flatus alone had been passed by rectum, great abdominal distention and visible intestinal peristalsis had developed. At operation, performed April 23, 1929, no local cause had been found to account for the obstruction. In spite of this interference a severe degree of constipation had persisted and finally only enemas had procured evacuation of the bowels; even in very large doses purgatives had been ineffectual. Attacks of abdominal distention had been frequent.

January 25, 1930, she came to the clinic on account of a whitlow. It was discovered that her bowels had not been open for thirteen days, although this state of affairs seemed to cause her so little discomfort that at first she was reluctant to undergo any treatment for her obstipation. It was exceedingly difficult to secure an evacuation of the bowel by any means; the lower part of the colon and the rectum lacked sufficient power to expel enemas. The report of a röntgenologic examination of the alimentary canal was as follows: "After twenty-four hours the colon is filled from end to end. The cæcum is already emptying a bit. The size and appearance of the colon is perfectly normal and it is movable. There is only one highly tonic place and that is at the splenic flexure where the size of the colon suddenly narrows. The rectum is full. After forty-eight hours, all the barium is in the descending colon and rectum."

After every medical method of improving the patient's condition had been tried without success, we determined to advise interruption of the sympathetic nerves supplying the distal part of the colon and the rectum. The operation was performed March 11, 1930. Some filmy adhesions between loops of the ileum and the abdominal wall were readily separated. The presacral nerve, which had a plexiform arrangement, was easily isolated and divided in front of the fifth lumbar vertebra. At this stage of the operation, an assistant inserted a finger just within the rectum. When the nerve was first grasped with a hemostat, the internal sphincter was felt to contract. After division of the nerve, stimulation of its peripheral end with a faradic current gave rise to a strong clonic contraction of the sphincter, followed by several weaker clonic con-

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tractions. The branches joining the presacral nerve from the third lumbar ganglia were then divided, as were also its lateral roots. The middle root was traced up to the inferior mesenteric artery (Figs. 5 and 6.) One or two branches which passed from ganglia on this root to the inferior mesenteric nerves were first divided, and on carrying the dissection a little higher two trunks were found on the right side forming roots of the inferior mesenteric nerve, a larger at the position of seven o'clock and a smaller at ten o'clock. The inferior mesenteric artery was then mobilized and a large root of the inferior mesenteric nerve was found on the left side at the position of five o'clock. These roots were resected. The incision in the posterior peritoneum was then closed, and the abdominal wound was sutured in layers. Convalescence was uneventful. An



FIG. 5.

FIG. 5.—(Case II). Structures removed at operation.

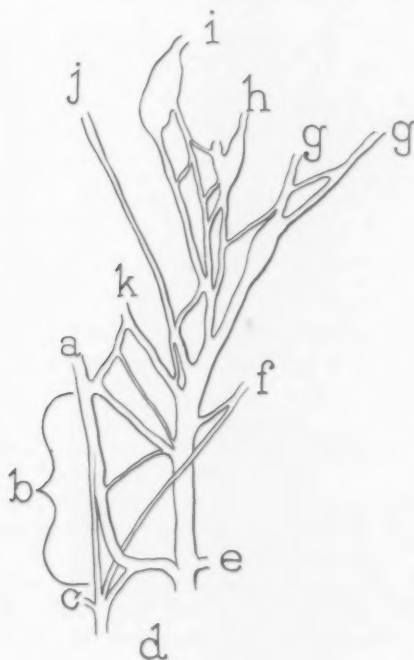


FIG. 6.

FIG. 6.—(Case II). Drawing of gross specimen shown in Figure 5. The nerves were dissected out after the specimen had been treated with 50 per cent. peroxide of hydrogen; *a*, right lateral root of presacral nerve; *b*, vertical extent of presacral nerve; *c*, branch from right third lumbar ganglion to presacral nerve; *d*, presacral nerve dividing into hypogastric nerves; *e*, branch from left third lumbar ganglion to presacral nerve; *f*, additional branch from left lumbar sympathetic chain to presacral nerve; *g*, left lateral root of presacral nerve, and *h, i, j, k*, fibres from intermesenteric plexuses forming middle root of presacral nerve. From the ganglionic masses on *h* and *i* branches passed to the inferior mesenteric nerves.

encouraging feature was increased ability to expel the enemas by which the colon was emptied while the patient was confined to bed.

Three weeks after the operation her physician noted: "Clinically, the patient is decidedly improved. She is able to expel enemas with ease, and at intervals has bowel movements of her own volition. I have instructed her to work on a regular program of going to the toilet, attempting evacuation of the bowels, and only using oil instillations if not successful, and water enemas as little as possible."

Six weeks after operation she reported that she was somewhat better; that enemas were still required to secure evacuation of the bowels, but that she was better able to expel them.

COMMENT

The post-operative course of patients suffering from Hirschsprung's disease will be different from that of patients suffering from rectal constipation. This must be emphasized. More immediate benefit is to be expected in the former, for after the operation the hypertrophied musculature of the colon is immediately available for effective peristalsis. It cannot be expected that completely normal defecation will be restored at once, for time will be required for partial or complete readjustment of the organic changes in the colon and rectum to the altered neuromuscular control. Judging from the case we have reported, however, satisfactory defecation begins sufficiently soon to obviate a long course of medical treatment.

In cases of rectal obstipation, not only is hypertrophy of the muscular coat of the bowel absent, but also the long-continued distention of the rectum leads to atony and even atrophy of its musculature. All that can be hoped for is that the rectum will be placed under the most favorable conditions for carrying out its function. A long course of after-treatment will be necessary to reëducate what remains of the rectal musculature, so that it will contract on an appropriate stimulus. As a corollary, it would appear that the operation will be followed by the best results when it is undertaken before profound atony or extensive atrophy has occurred.

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SPLANCHNIC ANÆSTHESIA IN THE TREATMENT OF PARALYTIC ILEUS

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WHILE paralytic ileus may supervene in the course of mechanical ileus, it is generally believed that mechanical factors play a minor rôle in the majority of cases of paralytic ileus. The occasional occurrence of paralytic ileus in kidney colic as well as in other extraperitoneal lesions is ample evidence that the nerve control of the bowel may be a basic factor in the production of paralytic ileus. The essential factors influencing the nerves controlling the bowel which result in paralysis of the bowel are not known, and are probably variable, being purely reflex in some instances and chemical or toxic in others. It is possible that the nerves controlling the motility of the bowel may be affected directly by local inflammatory processes, or by reason of toxins reaching them through the blood-stream.

Markowitz and Campbell¹ have shown that abdominal trauma or chemical irritation of the peritoneum by intraperitoneal injection of weak iodine solution results in cessation of peristaltic waves in the small intestines of animals. Motions of the bowel described by Cannon² as segmentation, propulsive waves and swaying or pendulum motion, are dependent on at least three different systems of nerve supply; namely, the enteric, the sympathetic and the parasympathetic. The enteric system, consisting of the plexuses of Meissner and Auerbach, may act independently of the other two as shown by Bayliss and Starling.³ They showed that intestine isolated from the central nervous system was capable of performance of the characteristic movements. The parasympathetics, or vagus nerves, have an excitatory effect on the muscular activity of the small bowel through the central nervous system. The vagus is therefore essentially motor in its action on the bowel. The splanchnic nerves, or sympathetic system, have an inhibitory effect on intestinal movements and when stimulated cause cessation of intestinal peristalsis.⁴ When the splanchnic nerves are paralyzed, marked intestinal movements are noted due to the uninhibited action of the vagus nerves.

The clinical effects of spinal anæsthesia on intestinal movements were first described by Wagner,⁵ in 1922, when he reported the occurrence of the evacuation of the bowels after spinal anæsthesia and also noticed active peristalsis of the small intestine during laparotomy performed under spinal anæsthesia. This effect was explained by the paralysis of the inhibitory splanchnic nerves. Wagner then used lumbar anæsthesia in the treatment of paralytic ileus caused by peritonitis in a number of patients, with good results. Following his report there were a number of reports made in

DAVID AND LORING

CHART I

Duval's collection of 400 cases of ileus treated by lumbar anaesthesia

	Cases	Success	Per cent
1. Strangulated hernia.....	257	27	10
2. Dynamic ileus.....	44	30	38
3. Mechanical ileus.....	99	16	16
<i>Dynamic ileus</i>			
Spasmodic.....	8	8	100
Post-operative.....	11	9	90
Ileus without known cause.....	2	2	100
Ileus in peritonitis.....	18	10	55
Reflex ileus (renal colic).....	1	0	0
Ovarian cyst twisted pedicle.....	4	1	25
<i>Mechanical ileus</i>			
Volvulus.....	53	7	13
Bands of adhesions.....	25	5	20
Carcinoma of colon.....	17	4	24
Intussusception.....	3	0	0
Biliary ileus.....	1	0	0

France and Germany on this subject. Duval⁶ collected the data on 400 clinical cases of ileus treated by lumbar anaesthesia (see chart). Markowitz and Campbell produced reflex cessation of intestinal motions in dogs by laparotomy, by severe intraperitoneal trauma and by intraperitoneal injection of weak iodine. They were able to reestablish intestinal movements under these conditions by lumbar anaesthesia and in some instances to demonstrate hyperperistaltic movements.

It is obvious that the best results from increase of peristalsis would be in the different types of paralytic ileus, for it is not reasonable to believe that the mere increase of peristaltic waves would overcome definite mechanical factors. Duval's collected cases bear out this assumption.

In most cases of paralytic ileus, as seen in general peritonitis, the patient is extremely toxic, the blood-pressure is low and the cardiovascular system is at low ebb. To induce lumbar anaesthesia with consequent paralysis of the extremities, as well as to still further lower the blood-pressure, or in some instances to interfere with respiration, is a somewhat heroic procedure. Undoubtedly, with these facts in mind, Rosenstein⁷ induced splanchnic paralysis by the injection of weak nicotine solution into the celiac ganglia. He used the posterior route for injection as described by Kappis, and reported some good results in the treatment of paralytic ileus. Ochsner, Gage and Cutling⁸ then studied the effect of splanchnic anaesthesia induced by novocaine injected posteriorly into the splanchnic plexus in dogs which had previously had a cessation of intestinal movements by reason of intra-abdominal trauma or by chemical irritation of the peritoneum by weak iodine. They found after splanchnic anaesthesia that intestinal movements were restored and advocated the method for the treatment of paralytic ileus.

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The most dreaded and most frequent cause of paralytic ileus is generalized peritonitis. Whether the ileus is due to the absorption of toxins and their effect on the nerves influencing intestinal movements, or whether to paralysis of the bowel from the direct local action of the bacteria, their toxins or the exudate produced, is not definitely known. Sampson Handley⁹ has expressed the view that one or more loops of bowels become paralyzed by local action of bacteria and their toxins and that a mechanical ileus develops above the paralyzed area. This may be true in the early stages of peritonitis but is not generally believed to be the fundamental cause of paralytic ileus in peritonitis where relatively early paralysis is the outstanding picture, as contrasted to hyperperistalsis above the point of obstruction in ileus due to mechanical causes. The treatment of the peritonitis is therefore of utmost importance in the prevention and abortion of beginning of paralytic ileus. This means early operation, closure or removal of the source of the peritonitis, quick operation with as little trauma as possible and drainage of the dependent portion of the peritoneum. The stomach must be kept empty by aspiration or Rehfuß tube, the loss of fluids and especially the loss of salt must be replaced by the use of normal salt solution subcutaneously, or by the use of hypertonic salt solution intravenously. Ileostomy has a doubtful position in the picture. Experimentally, Hayden and Orr¹⁰ have not found it of value though there are clinical reports favoring its use. Personally we have had very little help from ileostomy in paralytic ileus in general peritonitis. While all or most of these various procedures have been used without establishment of bowel function, is it advisable to turn to lumbar or splanchnic anæsthesia for help? In the following experiments we have aimed not only to repeat the work on the effect of splanchnic anæsthesia in the reestablishment of intestinal movements after chemical irritation of the peritoneum, but also after the development of local and general suppurative peritonitis and after chemical peritonitis which has produced a marked plastic exudate, and which, therefore, due to local injury to the bowel, might be a factor in the prevention of normal intestinal movements.

Experimental work.—Moderate-sized, healthy dogs were used. Barium was given in their food for several days preceding the experimental work and in a few instances it was introduced by stomach tube.

Splanchnic anæsthesia was induced by the injection of $\frac{1}{2}$ per cent. novocaine-adrenaline solution by the posterior method of Kappis. Methylene blue was included in the solution in many of the experiments so that at post-mortem it was possible to determine the exact location of the anæsthetic medium injected. After several dissections it was found that at the level of the lower border of the twelfth rib, about three centimetres from the mid-line posteriorly, a needle inserted toward the body of the first lumbar vertebra at an angle of 30° to 35° struck the vertebral body near its anterior surface. The direction of the needle was then changed so that the point slipped over the anterior surface and at that point twenty cubic centimetres of $\frac{1}{2}$ per cent. novocaine-adrenaline solution was injected on each side.

When chemical irritation of the peritoneum was desired, ten cubic centimetres of

equal parts of 2 per cent. solution of iodine and 2 per cent. solution of potassium iodide was injected intraperitoneally (Markowitz and Campbell).

To produce local or general suppurative peritonitis the appendix was ligated and allowed to slough off. In some instances the peritonitis remained local and in others it became general. The experiments on intestinal movements were performed two to four days after ligation of the appendix.

In a few dogs general peritonitis was produced by injection of thirty cubic centimetres of a 50 per cent. glucose solution intraperitoneally, followed in four to six hours by the intraperitoneal injection of a culture of *B. coli*.

To produce a chemical peritonitis with plastic exudate five cubic centimetres of a 10 per cent. turpentine emulsion was injected intraperitoneally. If, in twenty-four hours, peristalsis was visible by X-ray, another injection was given.

In other dogs a severe sero-hæmorrhagic peritonitis was induced by the injection of forty cubic centimetres of a suspension of *B. coli* in 2½ per cent. solution of gum of tragacanth in normal salt solution (Steinberg and Goldblatt¹¹).

Splanchnic anaesthesia was given only to dogs in which there were no visible peristaltic waves when examined under a fluoroscopic screen.

Experiment 1.—The intestinal motions of normal dogs were studied for several days in order to accustom the dogs to the X-ray room and to remove the possibility of reflex inhibition of intestinal movements. Following splanchnic anaesthesia in these dogs there was a definite increase in intestinal motions in all three dogs. The barium was seen to be vigorously propelled ahead and two of the dogs had several loose bowel movements about one-half hour after the splanchnic anaesthesia.

Experiment 2.—The effect of chemical irritation on intestinal movements. In three dogs weak iodine solution was injected into the peritoneum and upon examination immediately after the injection under the fluoroscope no peristaltic waves were seen. Following splanchnic anaesthesia normal peristaltic waves returned in two dogs within ten minutes and hyperperistalsis developed in the third dog. In control dogs receiving intraperitoneal iodine the peristaltic waves remained absent for at least an hour following the injection.

Experiment 3.—Effect of local peritonitis on intestinal motions. Following ligation of the appendix in four dogs, local peritonitis with plastic exudate around the appendix developed. Peristaltic movements of the intestine were not visible under X-ray. Following splanchnic anaesthesia two dogs had a return of slight peristaltic waves and two had active movements of the small intestine.

Experiment 4.—Effect of plastic peritoneal exudate from the intraperitoneal injection of turpentine emulsion upon intestinal movements. (a) In two dogs receiving intraperitoneal injections of turpentine emulsion practically no plastic exudate was formed although the peritoneum was hyperæmic. There was an absence of visible peristaltic waves when examined under the fluoroscopic screen. Following splanchnic anaesthesia, active peristalsis returned in both animals.

(b) Three dogs developed a slight plastic exudate throughout the peritoneum following the injection of turpentine emulsion intraperitoneally. Peristaltic waves were not visible. Following splanchnic anaesthesia active peristalsis was observed in two dogs and one developed a diarrhoea, but in one animal no peristaltic waves returned.

(c) Eight dogs developed a marked plastic exudate in the peritoneum following the intraperitoneal injection of turpentine emulsion. Intestinal peristalsis was not visible under X-ray. Following splanchnic anaesthesia three dogs showed slight peristalsis, and five dogs had no return of visible peristalsis.

Experiment 5.—Effect of general suppurative peritonitis. (a) One dog developed acute suppurative peritonitis following ligation of the appendix. Intestinal movements were absent as observed under the fluoroscopic screen and following splanchnic anaesthesia no return of peristalsis was seen.

SPLANCHNIC ANÆSTHESIA IN ILEUS

(b) Two dogs developed marked suppurative peritonitis following the injection of hypertonic glucose and *B. coli*. Peristaltic waves were not visible by X-ray. Following splanchnic anæsthesia slight movements of the small intestine were seen. It is interesting in these experiments to note that practically no plastic exudate was present.

(c) A series of dogs was given intraperitoneal injections of tragacanth and *B. coli*. A generalized sero-hæmorrhagic peritonitis developed rapidly. The five dogs included in this group had a severe generalized peritonitis at autopsy but were not moribund at the time the experiment was performed. Under the fluoroscope no peristaltic waves were seen in the intestines, and after splanchnic anæsthesia no peristaltic waves, with the exception of one dog, were observed. In one dog very slight intestinal motions returned.

Comment.—While it is thoroughly appreciated that these experiments on dogs cannot be unreservedly applied to the human they nevertheless serve that purpose in a large measure. It is evident that our results on the cessation of intestinal peristalsis following irritation of the peritoneum and their reestablishment after removal of the inhibitory effects of the splanchnic nerves tally with the work of Markowitz and Campbell as well as with that of Ochsner, Gage and Cutling. When, however, a full-blown peritonitis is established either by bacteria or by a chemical irritant, as turpentine, we have found that the *more severe* and the *more extensive* the peritoneal irritation, and the *more plastic exudate that is laid down*, the *less* likely it is that intestinal movements will be reestablished by splanchnic anæsthesia. In the most marked instances of general peritonitis, whether the cause be bacterial or chemical, intestinal movements are not demonstrable after splanchnic anæsthesia. This leads one to speculate as to whether the cause of the permanent cessation of intestinal movements as a result of either chemical or bacterial peritonitis is due to the local action of the inflammation affecting the bowel wall and including its nerve supply. Further study of this question is pending.

CONCLUSION

Based on this experimental work the employment of splanchnic anæsthesia to paralyze the inhibitory nerves of the intestine in the treatment of paralytic ileus from peritonitis may be of use in local peritonitis and in the early stages of general peritonitis, but in severe and extensive peritonitis little or no aid in the reestablishment of intestinal movements is to be expected.

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DISCUSSION: DR. D. E. ROBERTSON, of Toronto, remarked that it is over thirty years since Treves resected a megalocolon. Lane subsequently carried out the same treatment. The operation was very severe and the mortality high. In those cases that did survive the operation, the results were not such that would lead surgeons generally to undertake the proceeding. Royle noted in his first rami-section the patient was cured of constipation. Wade and he together reported five cases, two of which were cured. Fraser told me in 1926 that he was able to cure megalocolon by dividing the sympathetic nerves in the mesentery of the large intestine.

Royle's operation of rami-section is the easiest proceeding and the one that will give results in the cases of megalocolon. The operation is easy, much the simplest procedure that has been described in attacking the nerves that have to do with the sympathetic innervation of the large intestine. It is much more simple than the proceeding of opening an abdomen and hunting for the nerves after packing back the intestines. The flank operation allows one to extraperitoneally divide the fibres which go to control the sympathetic nerve supply of the intestine. He then showed lantern slides of two cases, both girls of nine years of age. They are both clinically cured. One I operated on in September, 1927. The first slide was taken in 1927, prior to operation, shows a very large megalocolon. The next slide, taken two years later following a rami-section of the mesial branches going from the left trunk, shows spontaneous movements the day following operation. Within two weeks she was averaging between five and ten movements a week. In the two years that have elapsed since her operation she required practically no help to secure bowel movements. One slide shows a barium enema taken two years after operation. Here will be seen that the colon, which formerly was of enormous dimensions, is now small and shows haustrations. The colon is, in reality, smaller than normal.

In the second patient before her operation the colon had a tremendous capacity. Following her operation of rami-section she had spontaneous movements. These movements were, in the first two weeks, daily. Following this movements became more frequent. She would have seven to twelve movements a week. This situation persisted until six months after operation when she returned to hospital complaining that she was having desire for movement and would go to stool three or four times a day and would pass small quantities only. Examining her abdomen at this time there was a palpable mass which could be indented. She was taken into hospital and with six enemas in three hours the large gut was evacuated and eight days later a slide taken after a barium enema showed the colon very small. The haustra are well marked.

His purpose in speaking was to call attention to the very practical operation of Royle. There is no operation that is as simple or has greater ability to give results. By its use one altogether eliminates the possibility of abdominal complications and sequelæ. Surgery as a whole owes a great

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debt of gratitude to Dr. Royle for his very interesting and practical observations in regard to large gut function and sympathetic control.

DR. W. J. M. SCOTT, of Rochester, New York, had felt that there was one other important step to be made in these cases, namely, to predetermine before operation if possible what effect we would get by removal of the sympathetic influence. He had studied in this way two cases of this disease. The first case was a typical example of Hirschsprung's disease in a seven year old boy. The motor activity of the bowel was studied with barium enemas. After a month of medical treatment, the large bowel still easily held four quarts of barium solution without discomfort or any sensation of fullness. His maximum effort only resulted in the evacuation of a small amount, not over a quart of the enema. Within five minutes, spinal anæsthesia was followed by an involuntary evacuation. This, assisted by his voluntary effort, resulted in the expulsion of three fourths of the enema within the next twenty minutes. Four hours after the spinal anæsthesia he had expelled all of the enema except a small amount in the recto-sigmoid. This was fairly conclusive proof that removal of the sympathetic innervation would benefit this boy and consequently he took out both lumbar sympathetic chains. Three weeks after operation he began to have regular spontaneous bowel movements for the first time in his life. The motor function of the colon was investigated again about two months after his operation. The first noteworthy change was that now two quarts of barium caused him discomfort and he had great trouble in retaining it. When asked to expel what he could, he evacuated all of the enema.

He had recently used this method in a case of very severe constipation in an adult. The test shows its value particularly well in the latter case. This patient had very severe constipation. A barium enema given, remained *in situ* for seven days, until the physician taking care of her feared obstruction would result and finally by repeated washing succeeded in emptying the bowel. Later the barium enema was repeated, spinal anæsthesia was given, and the patient was able to evacuate only a little of the barium from the rectal ampulla. The motor activity of the large bowel was not greatly augmented under spinal anæsthesia. The patient was saved an ineffective sympathectomy by the application of this test.

ILEOCÆCAL OBSTRUCTION ASSOCIATED WITH APPENDICITIS

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THE remote results of operations performed for chronic appendicitis show conclusively that a fairly large number of patients do not secure the relief of symptoms for which the operation was performed. While it is not possible, at this time, to enter into a review of all the pathological conditions which may follow or be associated with appendicitis in its acute or so-called chronic form, we desire to call attention to a lesion which is met with, not infrequently, in abdominal explorations for appendicitis; namely, ileocaecal obstruction. We believe that a certain proportion of the unfavorable results are due to a failure to recognize this type of obstruction. Our attention was directed first to the lesion in secondary operations undertaken for the relief of symptoms after appendectomy had been performed. As we have found the obstruction to be not uncommon and to be associated with chronic appendicitis, we believe that the exploration should include among other parts to be reviewed, the routine examination of the ileocaecal region and the patency of its valve.

Proof of the above statement as to the unsatisfactory results obtained in operations for chronic appendicitis is to be found in a review of a series of cases previously reported. Thus, Gibson,¹ in 1920, in a follow-up study of 555 cases of chronic appendicitis, of which 426 were heard from, found excellent results had been obtained in 259 cases; satisfactory results, that is, relief of the former condition but still having some minor symptoms, in sixty-five cases. The most frequent complaints were constipation, indigestion, and backache. In 102 cases the relief was not satisfactory, as in this group the pain persisted after the operation and was of four types: (1) vague symptoms, seen mostly in women (twenty-one cases); (2) pain in the appendiceal region (twenty cases); (3) same pain as before operation (twenty cases); and (4) pain in the epigastrium (seven cases). Gibson concluded that a more detailed pre-operative study and thorough exploration were necessary to obtain better results. He advocated a large incision, and even though the appendix is frankly infected, in the absence of contraindications, a thorough abdominal exploration should be made.

Deaver and Ravdin,² in 1923, reported the end-results in 500 cases operated upon for chronic appendicitis. Of the 226 patients traced, 188 were entirely relieved of symptoms, twenty-two partially relieved, and sixteen were unimproved. The figures indicating that 83.1 per cent. were relieved, 9.7 per cent. partially relieved, and 7.9 per cent. obtaining no relief, led the authors to conclude that a failure to obtain any relief was due to faulty pre-operative study and exploration.

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Holder and Menninger,³ in 1926, reported a follow-up study of 208 cases of chronic appendicitis. Approximately one-half of the patients were heard from and of this group, eighty-one, or 77.1 per cent., had complete relief. A study was made of twenty-two cases in which there were no pathological findings in the appendix, but mechanical factors occurred in the vicinity of the appendix. In this group, twenty, or 91 per cent., were relieved and two, or 9 per cent., experienced no relief.

Davis,⁴ in 1927, reported the results on 677 patients operated upon for chronic appendicitis. Following Gibson's grouping he found there were 221 excellent results, eighty-nine were satisfactory and 110, or 26 per cent., were unsatisfactory.

To summarize the end results of these several studies it can be concluded that 18 to 26 per cent. of the patients operated upon for chronic appendicitis are not completely relieved of their symptoms.

Most articles written upon disturbances of the ileocæcal valve as a cause of ileal stasis and attacks of pain, constipation, *etc.*, state that the stasis and its resultant symptoms are due to incompetency of the valve. No mention is made of obstruction of the valve playing any part in such cases. The only suggestion that the lesion is obstructive in character was made by Case⁵ in his X-ray studies of ileal stasis when he named spasm of the ileocæcal valve as one of the three causes of that condition. The ileocæcal valve serves a similar function between the middle and hind gut as the pyloric muscle does between the fore and middle gut. Innumerable studies and contributions have been made upon pyloric obstruction but, so far as we know, nothing has been written upon the incompetency of the pyloric ring. In the light of our experience with the cases we wish to present, this difference was all the more amazing, as it seems logical to us that we should have obstruction of the ileocæcal valve as we have pyloric obstruction, and the results obtained in our cases and the similarity in function of the ileocæcal valve to the pylorus suggests a greater consideration of the existence of ileocecal obstruction as an entity than has been given to it in the past.

Case, in 1913, made a very thorough röntgenological study of ileal stasis and suggested three causes: (1) adhesions to the terminal ileum; (2) ileocæcal sphincter spasm, first noted by Hertz in 1908; (3) incompetency of the ileocæcal valve. In more than fifty patients, Case definitely demonstrated regurgitation of the ingested bismuth from the colon into the small intestine. In every case of incompetency of the valve, gas or fluid distention of the terminal ileum was found at the operation. He suggested the following method to test the competency of the ileocæcal valve at the time of operation. The ileum is clamped by the fingers of the assistant twelve to fifteen inches from the valve and its contents milked into the cæcum. The normal ileocæcal valve prevents any regurgitation of the cæcal gas or fluid content into the ileum, even under considerable pressure. The incompetent valve, however, allows gas or fluid to pass back readily, varying with the degree of incompetency. In a study of 138 cases of ileal stasis Wallace⁶ concluded that incompetency of the valve was the dominant cause as he cured cases of ileal stasis by repair of the valve in instances in which the adhesions were not disturbed. After an extensive experience Kellog⁷ described a method of repairing an incompetent valve and another method of constructing an artificial

ileocaecal valve. He found that an efficient valve could be constructed by simple intussusception of the ileum into the large intestine. Such a valve worked perfectly, as it was impossible to inflate the colon through the ileum and distend it with considerable force without the occurrence of the slightest reflux. The construction of the new valve is indicated in cases in which the valve may be destroyed by disease or is necessarily sacrificed by surgical measures.

A brief consideration of the normal functions and the anatomical structure of the ileocaecal valve is necessary before discussing our group of cases of ileocaecal obstruction. Kellog has summarized the functions concisely as follows:

"Bauhim, Tulpius, and others of the early anatomists showed that the ileocaecal valve is a most efficient mechanical contrivance for preventing reflux of gas or liquid content from the colon into the small intestine. John Mason Good observed that, in addition to its mechanical structure, the ileocaecal valve possesses also a muscular function capable of acting as a sphincter. Elliott demonstrated, in 1904, that the valve behaves as a true sphincter in the dog, possessing like the pylorus a special nervous mechanism distinct from other parts of the alimentary canal. Sir William Macewen recorded the results of observations made upon a case in which, as the result of the destruction of a portion of the anterior wall of the caecum, it was possible to observe the action of the ileocaecal valve and a reciprocal activity of the appendix.

"Case, Cannon, and others who have made a systematic study of the alimentary canal by the aid of the X-ray have demonstrated that the ileocaecal valve not only prevents reflux of material from the colon into the small intestine, but also regulates the movement of material from the small intestine into the colon in a manner quite analogous to the action of the pylorus in passing digesting food from the stomach into the small intestine.

"That these functions of the ileocaecal valve must be highly important to the welfare of the body is a necessary inference from the fact that the structure is present in practically all vertebrate animals above the level of the amphioxus. The pylorus and the ileocaecal valve divide the alimentary canal into three parts, the functions of which differ in such a way as to require their isolation. These are known to anatomists as the fore-gut, reaching from the mouth to the pylorus; the mid-gut, including the small intestine, and extending from the pylorus to the ileocaecal valve, and the end-gut, or the large intestine. When, as a result of disease, reflux from the small intestine into the stomach occurs, the result is nausea, vomiting and serious interference with the functions of the stomach."

Cunningham⁸ gives the following excellent description of the ileocaecal valve as found in human beings:

"Where the ileum enters the large intestine, the end of the small gut is, as it were, thrust through the wall of the large bowel, carrying with it certain layers of that wall, which project into the caecum in the form of two folds, lying respectively above and below its orifice, and constituting the two segments of the ileocaecal valve. The conditions may be compared to a partial inversion or telescoping of the small into the large intestine; it must be added that the peritoneum and longitudinal muscular fibres of the bowel take no part in this infolding; on the contrary, they are stretched tightly across the crease produced on the exterior by the inversion, and thus serve to preserve the fold and the formation of the valve.

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"As seen from the interior, in the specimens which have been distended and dried, the valve is made up of two crescentic segments—an upper, in a more or less horizontal plane, forming the superior margin of the aperture, and a lower, which is also larger, placed in an oblique plane, and sloping upward and inward (*i.e.*, toward the cavity of the cæcum). Between the two segments is situated the slit-shaped opening, which runs in an almost anteroposterior direction, with a rounded anterior and a pointed posterior extremity. At each end of the orifice the two segments of the valve meet, unite, and are then prolonged around the wall of the cavity as two prominent folds—the frenula (*frenula valvulæ coli*). It is thought that when the cæcum is distended, and its circumference thereby increased, these frenula are put on the stretch, and pulling upon the two segments of the valve, they bring them into apposition, and effect the closure of the orifice.

"In bodies hardened *in situ* with formalin, the valve and orifice present an entirely different appearance, suggesting, much more closely than in the dried state, the appearance of telescoping or inversion mentioned above. In them, also, the two segments of the valve are much thicker and shorter, but they can always be distinguished, and are found to bear the same relation to one another as in the dried condition, although this may be obscured by foldings or rugæ. The aperture may be slit-like or rounded, with sloping or infundibuliform edges; the frenula are not so prominent at times; but the whole valve projects much more abruptly into the cavity of the cæcum than in the distended and dry specimen.

"Each segment of the valve is formed by an infolding of all the coats of the gut, except the peritoneum and the longitudinal muscular fibres, and consequently it consists of two layers of mucous membrane, with the submucosa and the circular muscular fibres between, all of which are continuous with those of the ileum on the one hand and of the large intestine on the other. The surface of each segment turned toward the small intestine is covered with villi, and conforms in the structure of the mucous membrane to that of the ileum; while the mucous membrane of the opposite side resembles the mucous coat of the large bowel.

"In the dried specimen the upper segment projects further into the cavity of the cæcum than the lower, so that the aperture appears to be placed between the edge of the lower segment and the under surface of the upper.

"There is little doubt, as pointed out by Symington, that the efficiency of the ileocecal valve is largely due to the oblique manner in which the ileum enters or invaginates the cæcum; this oblique passage alone, as in the case of the ureter piercing the wall of the bladder, would probably be sufficient to prevent a return of the cæcal contents. In the great majority of cases, when in position within the body, the ileum is perfectly protected from such a return, although when the parts are removed, and then distended with fluid, this often passes through the valve and reaches the small intestine. Still, the efficiency of such a test, applied when the parts are deprived of their natural supports, cannot be relied upon.

We have used the term "ileocecal obstruction" to include two types of cases: (1) actual obstruction of the valve produced by adhesions, causing invagination or angulation of the ileum directly at the valve; and (2) a disturbance in the motility of the terminal ileum produced by adhesions binding it to the lateral or posterior abdominal wall. In some cases the long-standing irritation occurring in chronic appendicitis probably produces the adhesions leading to obstruction either directly at the valve or in the terminal portion of the ileum. While we are interested chiefly in the cases of valvular obstruc-

tion, the lesions of the terminal ileum, due to kinking caused by adhesions (Lane⁹), are included as we have used free omental transplants in the treatment of both conditions.

The most constant and characteristic complaints, in addition to the usual symptoms of appendicitis, were constipation and flatulency. While the degree of constipation varied, with but few exceptions, all patients had to take cathartics. Apparently, the narrowing of the ileocaecal opening by preventing the intestinal contents from readily entering the cæcum, has been responsible



FIG. 1.—X-ray showing narrowing of ileum at the ileocaecal junction.

for the flatulency and, to some extent, for the development of constipation. Toxic symptoms, particularly headaches, were noted when constipation was of long duration. As similar symptoms occur in cases of visceroptosis with a low-lying mobile cæcum, the differential diagnosis from this condition is most difficult at times.

A gastro-intestinal study by means of the X-ray may reveal the ileocaecal narrowing and partial obstruction, as is shown in Fig. 1, although this finding is not constant and a positive diagnosis is not always possible by this means. In the event of negative X-ray findings, it has been our practice to recommend exploratory operation after a reasonable trial has been given to dietary and other measures carried out by the internist.

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When the ileocæcal region is inspected in many of these cases, the serosa is apparently normal. If an attempt is made to introduce a finger through the valve, by invaginating the ileum, the opening is found narrowed and at times cannot be demonstrated because of the dense adhesions and the degree of thickening of the ileum. (Fig. 2.) The adhesions at the junction of the terminal ileum with the cæcum were found without exception in the portion of the bowel adjacent to the posterior lip of the valve, as noted in Fig. 3. In several of the cases with marked constriction the adhesions extended around the bowel and involved the anterior lip. A positive diagnosis of valvular obstruction should not be made until attempts to introduce the tip of the exploring finger through the opening have been tried at several angles, as there are many variations of the angle at which the ileum enters the cæcum.

By means of careful dissection, the ileum can be released from the cæcum and gradually the opening will become apparent and the tip of the exploring finger can be passed through the valve. One-half to two centimetres of the bowel may be separated by this means before a sufficient degree of patency is obtained. (Fig. 4.) When the outer coat of the cæcum is reached, a definite change in texture is observed: the tissue is firmer, does not separate as readily as do the adhesions, and this is an indication that further dissection may be dangerous by injuring the valve.

Thickening of the wall of the terminal ileum is frequently seen and this may be so pronounced that the bowel feels like and resembles the structure of the jejunum. The cause of the hypertrophy may be explained by the fact that extra work is thrown upon this portion of the ileum in an effort to force the bowel contents through the obstructed ileocæcal valve. In this connection the observation of Keith may be of importance, for he believes that the musculature of the terminal portion of the ileum, four inches above the valve, is endowed with a special tonic function whereby it serves as a sphincter for the terminal portion of the ileum.

After examination of the ileocæcal valve the terminal ileum is explored and an attempt is made to deliver it from the abdomen. If adhesions are present, binding the bowel to the lateral abdominal wall, the angulation of the bowel is noted, and, if of minor degree, the bands are not disturbed.

In the more pronounced cases, in which surgical interference is indicated, the bowel is firmly bound by adhesions to the lateral wall, cannot be delivered, and may be angulated. The hypertrophy of the terminal portion of the

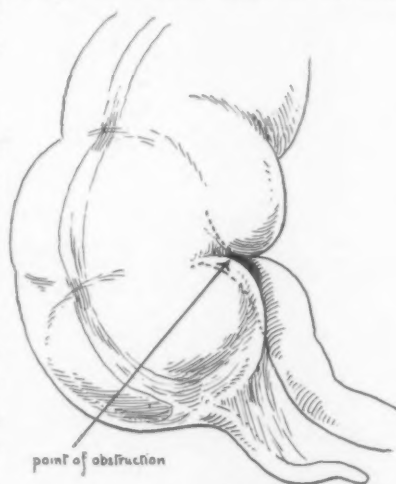


FIG. 2.—A diagrammatic representation of invagination of ileum producing ileocæcal obstruction.

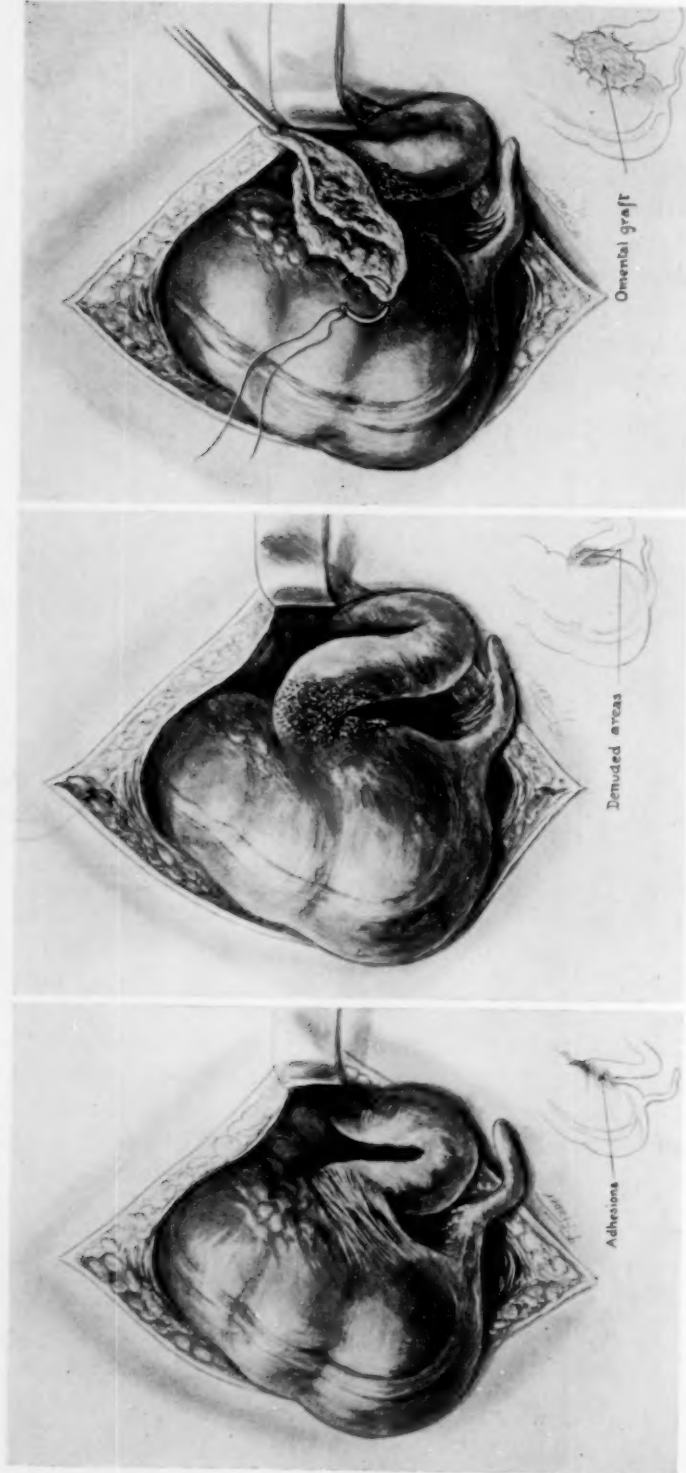


FIG. 5.—Omental graft sutured over defect.

FIG. 4.—Serosal defect produced by freeing of adhesions.

FIG. 3.—Valvular type of obstruction showing adhesions.

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small bowel is most pronounced in these cases. MacKinley,¹⁰ in noting the hypertrophic changes in the bowel wall in this type of case, states that ileal kinks are caused by the cicatrization of the lower leaf of the mesentery of the ileum, as a result of recurrent attacks of appendicitis, and thinks that this cicatrization interferes with the return of blood through the colic vessels supplying the ileocecal region and produces a chronic congestion in the walls of the distal portion of the ileum. This congestion, persisting over a period of time, causes a hypertrophy of the tissues of the ileum. The anastomosis of the ileocolic with the right colic enables the venous blood of the first portion of the colon to escape without causing congestion and hypertrophy of the first portion of the colon.

After the release of the adhesions, the bowel can be delivered into the wound, is freely movable and the angulation is entirely overcome. The resulting serosal defect in both the above conditions is then covered by a free omental graft. (Fig. 5.) A thin and well-vascularized portion of the greater omentum is used as we have found this the most satisfactory type of graft. The transplant is carefully sutured over the serosal defect, using many sutures to obtain good approximation, as adhesions to the edge of the graft occur less frequently when this precaution is observed. The raw edge of the greater omentum, from which the graft is taken, is buried between the two layers of the omentum to prevent it from becoming adherent to the graft or other abdominal viscera.

The following case histories are abstracted briefly in order to illustrate the commonest types of pathologic lesions encountered, the symptoms they produced, and the means employed to correct the condition.

CASE I.—V. A., a male, forty-three years of age, was admitted to the Presbyterian Hospital with the chief complaint of pain in the abdomen. For the past two years the patient has suffered from flatulency, for which frequent cathartics were taken. Following the catharsis he experienced pain in the lower right quadrant of the abdomen. For the first few months of his illness the pain was nothing more than a dull ache and lasted approximately twenty-four hours. Subsequently the attacks increased in frequency, length of duration, and the pain was more severe. A week before admission, he experienced an attack which continued four days and the pain was very sharp and intermittent. Appetite has been poor because of the tendency to gas formation and constipation. During the past two years he has had many dull headaches which have also increased in frequency and severity. Upon physical examination, the abdomen was slightly distended and there was moderate tenderness, but no rigidity over McBurney's point. Urine analysis was negative, and a fractional gastric analysis showed a normal curve. An exploratory operation performed through a lower right rectus incision disclosed a partially obliterated appendix which was moderately inflamed. Upon examination of the ileocæcal junction the terminal ileum was found to be adherent to the cæcum and so fixed by dense adhesions, that the valve would not admit the tip of the little finger. The adhesions were dissected at the ileocæcal junction separating one and one-half centimetres of the posterior portion of the terminal ileum. Following the liberation of these adhesions the valve could be entered easily with the index finger. The resulting serosal defect was covered with a free omental transplant. The patient made an uneventful recovery and two years after operation, reports that the headaches have disappeared, constipation has been completely relieved, and the use of cathartics

has been discontinued after being used continuously for many years. This case illustrates the most typical form of ileocaecal obstruction accompanied by toxic symptoms and attacks of pain. The degree of obstruction found at the operation readily explained the cause of the attacks of intermittent sharp pains in the right lower quadrant of the abdomen following catharsis. We believe the ileocaecal obstruction was the source of the patient's symptoms, and relief would not have been obtained by simple appendectomy.

CASE II.—P. M., a male, fifty years of age, was admitted to the Presbyterian Hospital with a chief complaint of pain in the right lower quadrant, and constipation which had become more pronounced during the past two months. Six weeks before admission he developed a dull, intermittent pain which did not radiate and was not accompanied by nausea and vomiting. The attack lasted forty-eight hours and since that time he has suffered from a dull ache and considerable abdominal distention. Upon examination of the abdomen, no tenderness or rigidity were found and no masses were palpable. A fractional gastric analysis showed an absence of free hydrochloric acid; the highest total acidity was 22. Urine analysis was negative. An exploratory operation was performed, and an inflamed appendix, which was kinked and doubled upon itself, was found in the retrocaecal space and removed. The ileocaecal valve was found to be normal; however, there was definite kinking of the ileum about four inches from its termination, due to adhesions binding it down to the lateral wall. The adhesions were severed, the kink relieved, and the resulting serosal defect was covered with a free omental graft. The transverse colon was found to be adherent over the anterior surface of the ascending colon just above the caecum producing a definite angulation at the hepatic flexure. These adhesions were freed and the raw surfaces oversewn. The patient was discharged from the hospital fourteen days after operation, relieved of his acute symptoms. His bowels have moved regularly and there has been no recurrence of symptoms, two years after the operation.

This case is presented as an example of a disturbance of the motility of the terminal ileum, caused by adhesions binding this portion of the bowel to the lateral wall; there was no apparent obstruction in the ileocaecal valve.

Twenty-three cases have been operated upon during the past two years and the condition was found most frequently in the third and fourth decades of life. The duration of symptoms varied from a few months to twenty years; in nine patients symptoms were present less than one year, six from one to three years, and two were of twenty years' duration. A history of constipation with the use of cathartics was noted in seventeen cases, gas pains accompanied the constipation in nine cases, and toxic symptoms were noted in four instances. The more severe cases with pronounced constipation had the valvular type of obstruction. The character of the pain was not constant; in nine patients it consisted of a dull ache which was present more or less all the time. Fourteen patients experienced attacks of pain sufficiently severe to be considered as acute appendicitis. Of the twenty-three cases studied, thirteen had the valvular type of obstruction, and in ten there was kinking of the terminal ileum. Twelve of the thirteen patients having valvular obstruction suffered from constipation and gas pains, whereas only seven of the ten patients with kinking of the terminal ileum had these complaints. This is about what is to be expected when the difference in the narrowing of the lumen of the bowel is considered in the two conditions. It is also of interest to note that twelve of the thirteen patients with valvular

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obstruction had severe attacks of pain, whereas the pain was severe in only five of ten cases with adhesions to the terminal ileum. Three cases had previous appendectomies without symptomatic relief. At the second operation a kink was found in the terminal ileum in one patient, and two had pronounced valvular obstruction. In all three instances there was severe constipation accompanied by gas pains and toxic symptoms. In one case there was no improvement; in the second case the constipation was greatly improved and toxic symptoms disappeared; and in the third case slight constipation persisted but complete relief of pain and toxicity was obtained. Free omental transplants were used in eighteen cases; in five instances the resulting serosal defect was small, and could be covered by suturing. Our follow-up study upon these patients was most encouraging. Of the twenty-three cases, twenty were heard from, and in fourteen there was complete relief of the constipation, gas pains and toxic symptoms. In two patients the constipation was partially relieved and there was complete relief of other symptoms. In two cases there was improvement in the degree of constipation and relief of other symptoms, but the patients have been operated upon so recently they cannot be classified as cures. In two patients there was no relief of the constipation but there was complete relief from the attacks of pain.

CONCLUSIONS

1. Routine exploration in chronic appendicitis, and in acute appendicitis when justifiable, should include an examination to determine the patency of the ileocæcal valve.
2. A certain proportion of the poor remote results in operations for chronic appendicitis may be attributed to failure to note ileocæcal obstruction and to properly relieve it.
3. Relief obtained by freeing adhesions followed by the use of omental transplants has afforded sufficiently favorable results in overcoming the obstruction to justify the employment of this procedure.

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DISCUSSION: DR. HUBERT A. ROYSTER, of Raleigh, N. C., called attention to the importance of the associated conditions around the ileocæcal region in the consideration of appendicitis, both of the acute and the recurrent types. For many years surgeons failed or rather declined to pay very much attention to the so-called kinks or other forms of adhesions and as the result the patients came back with secondary symptoms. Now all examine the region and pay attention to these several kinks, but this question of ileocæcal obstruction brought up by the authors is of equal importance. Curiously enough, some years ago he stumbled on the question by accident in pulling out the ileum as far as it would go and found it folded upon itself in two cases like an accordion. In both those cases he did the same thing as the authors have suggested, found that he had a raw surface and did an omental graft. Following this up he made it a point to use this same method of drawing the ileum and the cæcum away from each other.

Dr. Speese in closing said:

I was perfectly aware that attention has been called many times to the intrinsic incompetency of the ileocæcal valve. That is not a new subject, but there is an extrinsic obstructive incompetency which sometimes exists without any incompetence of the valve itself. The Bauhin valve is not a circular or constricting area but a slit-like opening which perhaps performs its function like the mouth of a fish, so that there is no particular reason why we should have a circular obstruction as we do in ulceration at the pylorus. The important point is that when one gets through the operation of removing the appendix to determine positively whether the ileum enters the cæcum at a right angle. If it does not, then attention should be paid to this region by pulling them apart.

In conclusion he mentioned a very important anatomical matter which was first pointed out to him by Payne, of Norfolk, Virginia. He made the observation that the vessels of the terminal ileum, that is within three to four inches of the cæcum, run parallel with the axis of the bowel and not transverse as in the rest of the small intestine. So that one knows that one has approached the end of the ileum, the very end, when one observes the vessels for two to three inches running toward the cæcum instead of around the bowel.

DIVERTICULA OF THE SIGMOID

BY WILLIAM J. MAYO, M.D.

OF ROCHESTER, MINNESOTA

MY INTEREST in diverticula of the intestinal tract was first aroused by the classical contribution of Reginald Fitz in 1888, on diverticula of the intestine, although this paper was devoted largely to diverticula of the Meckel type.

Diverticula of the colon were first described by Cruveilhier, in 1849. In 1857, Habershon, a physician, published the first account of diverticulitis in English. In 1858, Sidney Jones reported a striking case of acute diverticulitis which resulted in a fistulous connection between the bladder and the sigmoid. However, attention was not generally attracted to diverticulitis of the sigmoid until 1889, when Graser of Erlangen emphasized the frequency and significance of the disease. The first comprehensive treatise embodying both etiology and classification was brought out by Edwin Beer in 1904. This has been followed by papers by Telling, Drummond, Mummery, Hartwell, Brewer, Rogers, Mailer, and others. In 1907, Moynihan's classical paper on its mimicry of carcinoma of the colon appeared, and this deservedly received much attention. In 1907, Wilson, Giffin, and I reported five cases in which a portion of the sigmoid was excised for obstructive diverticulitis with the formation of tumor; these were the first instances recorded in which an actual demonstration of the pathologic change in diverticulitis was made during the life of the patient.

There are two types of diverticula of the colon, the true and the acquired. In true diverticula of the congenital, traction, or pulsion types, all the intestinal coats cover the sac. In diverticula of the acquired type, the mucous membrane of the intestine pouches through small openings in the musculature at weak points in the wall of the colon, such as holes for vessels or defects of muscle. Such diverticula often contain small hardened fecal masses. The sigmoid nearly always is involved in diverticulosis. If the entire colon is affected, there usually is a gradual increase in the frequency of the diverticula from right to left. The diagnosis of diverticulosis now rests securely on radiographic evidence.

Records at the clinic show a total of 2,139 cases of diverticulosis. Robertson's observations on our post-mortem service show that 5+ per cent. of persons more than forty years of age have diverticulosis, and his data approximate as to frequency those based on X-ray evidence. Thus, in the period from 1924 to April 1, 1930, inclusive, 31,838 X-ray examinations of the colon were made for general diagnostic purposes, and in 1,819 of these (5.71 per cent.) diverticula were present. Only twenty of these 1,819 patients were less than forty years of age. Of our 2,139 recorded cases of diverticulosis, active diverticulitis was present in 696 at the time the patients

were examined. Inasmuch as in the earlier period, prior to 1916, only the cases of diverticulitis were recognized and properly recorded, these figures are of little value in establishing the frequency with which diverticulosis gives rise to diverticulitis. Statistics of the later period give 12+ per cent. of cases of diverticulosis resulting in diverticulitis, but for obvious reasons this is probably an overestimate. A study of the relative incidence of diverticulosis in men and women in this group of cases showed that 64 per cent. of the patients were men; 36 per cent. were women. As constipation is more common in women, these figures would seem to show that it is not an important factor in the causation of diverticulosis. Nor can much significance be attached to obesity as an etiologic factor, inasmuch as the percentage of patients who were underweight was about the same as that of those who were overweight.

CLINICAL FEATURES.—With rare exceptions, the type of inflammation of diverticula which we speak of as diverticulitis is confined to the sigmoid. The inflammatory condition usually is limited to one or several diverticula, but a considerable length of the bowel may be obstructed and greatly thickened from œdema and adhesive inflammation; thus a well-marked tumor in the lower part of the abdomen to the left of the median line often, if not usually, forms during the acute stage. Cases of the disease may be classified clinically into four groups.

Group 1. Self-limiting diverticulitis and peridiverticulitis.—The symptoms of acute diverticulitis are pain in the region of the mass, which often is palpable, a moderate degree of fever, and gaseous distention. As a rule these symptoms are not severe, and, although the temperature may be elevated one or two degrees, the patients are often ambulatory after the first day or two, and the tumor usually disappears in the course of a few weeks.

Group 2. Diverticulitis and peridiverticulitis with formation of abscess resulting in entero-intestinal, enterovesical, enterocutaneous, and other fistulae.—This group includes those cases in which infections (either localized peritonitis with formation of abscess, or the results of infectious processes which connect the diseased sigmoid with the neighboring intestine, the bladder, or the skin) lead to the necessity for surgical interference. Rarely, an infected diverticulum in the terminal portion of the sigmoid may be the cause of an abscess resulting in an intractable fistula in the posterior anal region, as pointed out by C. H. Mayo.

Group 3. Diverticulitis complicated by obstruction of the bowel.—In acute diverticulitis the obstruction is the result of infection and œdema. Chronic obstruction is due to hyperplasia, adhesions, and angulation (the hyperplastic stenosing type). The conditions are practically identical with those in Groups 1 and 2, but the additional factor of obstruction in these cases is so serious a feature that it seems best to classify them independently. It is surprising, however, when the entire mass is dissected out and the diseased bowel laid open, to find so little actual obliteration of the lumen of

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the bowel, and, unlike cases of carcinoma of the sigmoid, the obstruction is rarely complete.

Group 4. Carcinoma developing on a diverticulum.—This group is of great interest. In rare cases the carcinoma may have such a definite relationship to the diverticulitis as to make it reasonable to assume that infection and irritation by hardened fecal masses in diverticula might have been the cause of chronic irritation and pre-cancerous change. Until recently, the only known fact of significance in the etiology of carcinoma was its relation to chronic irritation. Today the question of individual susceptibility to carcinoma is beginning to attract scientific attention. The term "pre-cancerous" is used to denote certain cell changes taking place in areas of chronic irritation, which would be typical of carcinoma if found in connection with invasion of the tissues.

It has often been pointed out that carcinoma of the sigmoid may progress very slowly. Cases have been reported in which colostomy was performed for the relief of obstruction due to supposed carcinoma; the patients lived for a number of years, and died from carcinoma of the sigmoid, a fact which was taken to prove that the condition had been carcinoma from the beginning, and that the natural course of the disease had continued for eight or nine years. This inference is unwarranted. In the clinic we have operated in several cases of this type, and on resection of the growth have found carcinoma developing in a sigmoid in which the results of an ancient deforming type of diverticulitis were present. In tracing the early histories of the patients it could be seen that the diverticulitis had been present from the beginning of the illness, and that the malignant change had been a more recent development.

In reviewing a series of specimens of sigmoid which had been resected for supposed carcinoma at the clinic, Wilson found that three, resected years ago, before all specimens were subjected as a routine to microscopic examination, showed diverticulitis and not carcinoma. The possible association of carcinoma with diverticulitis leads to the conclusion that when a tumor, appearing to be diverticulitis, but without acute symptoms, is found in the sigmoid or colon, and especially if the tumefaction subsides only partially and then continues as a chronic mass causing more or less marked symptoms, carcinomatous change is to be suspected, but the relation between the two remains conjectural. Some idea of the relative frequency of the two conditions in the sigmoid may be obtained from our own figures. In the stated period we dealt with 696 cases of diverticulitis and 2,354 cases of carcinoma of the sigmoid.

The distinction between diverticulosis and carcinoma of the sigmoid can usually be demonstrated by radiologic methods. These methods will usually also show a carcinomatous change in a diverticulous area of the sigmoid, but if diverticulitis is present, this diagnostic agent cannot be used so freely during the more acute stages of the process.

SURGICAL TREATMENT.—The treatment of diverticulitis of the sigmoid

depends on many factors. In acute cases, especially if the patient is old, obese, and a poor risk for operative procedures, it should be tentative. In our series of 696 cases, operation was performed for this condition in 26.18 per cent. If the infection goes on to the formation of abscess, the pus should be evacuated, instead of waiting for its spontaneous discharge, as the latter course tends to lead to the formation of a fistula, with its attendant evils. If more radical treatment appears to be necessary to effect a cure, it can be postponed to a later and more favorable time. If acute obstruction results, colostomy should be performed as close to the obstructed point as is convenient, so that at a subsequent operation the stenosed portion of the sigmoid and the colostomy opening may be excised simultaneously through the same incision; or, as advised by Stiles and by Burgess, cecostomy may be performed for temporary relief and the radical operation performed later if it becomes necessary. In other cases, colostomy may be resorted to for temporary relief, and the opening in the colon closed later, if the infective process regresses spontaneously sufficiently to restore the lumen of the colon.

If the patient comes for relief of an internal fistula, especially one communicating with the bladder or with another part of the intestinal tract, a serious problem confronts the surgeon, the operative risk being proportionate to the number of internal fistulae and to their situation. I know of no more trying operations than some of this character. In several instances I have dissected out multiple entero-intestinal fistulae communicating with the bladder and have carefully sutured the bladder and each intestinal opening; after several days, leakage to the surface has followed the line of drainage with temporary discharge of urine and faeces. However, these wounds eventually have healed. A very excellent technical step in such cases was first suggested, I believe, by C. H. Mayo. This consists in completely separating the involved sigmoid from adherent intestines and bladder, and, after suturing the fistulous openings, or resecting the diseased segment of bowel, in bringing the omentum into the operative field. An opening is made in the omentum through which the sutured portion of the sigmoid is brought to the peritoneal surface of the abdominal incision, where it is attached by a few sutures. The omentum is thus thrown between the defects in the colon, bladder, and adherent intestines, and, if leakage occurs later, a safe exit is provided.

CONSIDERATIONS ON THE ORIGIN OF ACQUIRED DIVERTICULA OF THE SIGMOID

The romance of medicine lies in inductive philosophy, in which tomorrow is the great day. Yesterday furnishes the deductive philosophy, which acts as a compass to keep our directions true.

In mammals the testis is the primitive procreative organ, and because of its long heredity it is relatively free from disease; the ovary, secondary to the testis, is a more recent acquisition which has not yet achieved the same resistance. So, too, the sigmoid, a convenient storage organ but of more recent development, has not yet achieved the stability of the primitive small intestine. The right half of the large intestine is derived from the midgut, and in the embryo has the same type of epithelium as the small intestine

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and carries on an absorptive function. The sigmoid is derived from the hind-gut, and has relatively little absorptive function. By reverse peristalsis derivatives of the food end-products are returned for further elaboration and absorption until the fecal stage is reached.

Certain recent investigations by Alvarez and his colleagues have shown the influence of food products on mass. Among the various types of food which form a mass, such common articles of diet as potatoes and milk form a relatively large mass, whereas red meats induce a large amount of bacterial action. Three-fourths of the peoples of the world eat rice for carbohydrate, and more or less fish for protein. Rice not only has a high-calorie content, but it also liquefies and forms only a very small mass; such articles of diet as fish also form a small mass. It would be interesting to know whether diverticulitis is as common in the rice- and fish-eating countries as it is in the potato- and red-meat-eating countries.

To one who has watched through the fluoroscope the spastic colon struggling with a barium content, it is not difficult to understand how and why pits form in the areas of weak musculature of the colon and along perforations made by its blood-vessels. Again, now that we are getting new light on the sympathetic nervous system, which acts as a brake on intestinal progress, we see a possible explanation of some of the phases of the development of diverticula. Learmonth and Markowitz have shown that after section of the inhibitory nerves to the colon of the dog, in certain cases, a barium meal may show appearances suggestive of early diverticulosis.

Speaking picturesquely, one notes various types of control over the vegetative functions, for example, the linking up of nonstriated muscle with the nodal system and with the internal secretions so largely instrumental in carrying on gastro-intestinal functions. These controls are shown in the occurrence of intestinal peristalsis once or twice in each minute and intestinal contractions eighteen or twenty times in each minute, the latter movements serving as a motor pump to propel venous blood in the portal system to the liver. All of these forms of stimulation are linked with the sympathetic nervous system, and through the sympathetic ganglions with the central nervous system. Our knowledge of this interrelationship we owe to the fundamental work of Gaskell and Langley.

The work of Hunter and Royle has stimulated fresh surgical interest in the sympathetic nervous system. In this field Adson and his associates have been able to relieve megacolon, which so closely resembles the dilated œsophagus in cardiospasm, by removal of the lumbar sympathetic ganglions and their communicating branches. The operation effects its purpose probably by leaving the sacral sympathetic outflow, which is motor to the distal part of the colon, in sole control of this part of the bowel. Adson and his co-workers have also brought about marvelous relief in Raynaud's disease, in certain types of contraction of the blood-vessels of the extremities leading to gangrene, and in certain types of arthritis, by removal of the appropriate sympathetic ganglions and their communicating branches.

END-RESULTS OF INGUINAL HERNIA OPERATIONS

BY CHARLES L. GIBSON, M.D.

AND

ROBERT K. FELTER, M.D.

OF NEW YORK, N. Y.

THIS is a report of the operations for inguinal herniæ done on the First Surgical Division (Cornell) of the New York Hospital from May, 1915, to August, 1928. The operators have been doctors Gibson, Hitzrot, Lee, Farr, Weeden, Cornell and Wade. Only ward cases are considered.

Number of patients..... 1618

Number of herniæ..... 1878

(260 bilateral)

Male..... 1508

Female..... 110

Number of patients with recurrences.....48 (2.9 per cent.)

Number of recurrent herniæ..... 57 (3 per cent.)

(In addition to the original forty-eight recurrences, this number includes three cases which recurred a second time and six double recurrences.)

Number of cases recurrent at time of first admission, having had operation at another hospital..... 51

(Of these two had had three previous operations; two had had two previous operations.)

Operative cure obtained in fifty of these cases.

Ages	No. of cases	Recurrences	Per cent. Recurred
1-10.....	153	1	0.6 per cent
10-20.....	193	0	0
20-30.....	467	13	2.7 per cent
30-40.....	374	15	4 per cent
40-50.....	276	13	4.7 per cent
50-60.....	128	4	3 per cent
60-70.....	22	2	9 per cent
70-80.....	5	0	0

Deaths..... 8 (0.4 per cent)

(In addition one case, age two, was transferred to contagious hospital where he died of scarlet fever.)

Follow-up Notes

Unknown.....	146
Deaths (in hospital).....	8
Deaths (Scarlet Fever Hospital).....	1
3 months.....	567
4 months.....	267
5 months.....	122
6 months to 1 year.....	341

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1 to 2 years	99
2 to 3 years	12
3 to 4 years	12
4 to 5 years	12
5 to 6 years	10
6 to 7 years	9
7 to 8 years	3
8 to 9 years	3
9 to 10 years	4
10 to 11 years	1
13 years	1
Per cent. of follow-up cases	90.9 per cent.

Types of Hernia

One side

Indirect	1320
To include	
Sliding of sigmoid	28
Sliding of cæcum	2
Sliding of tube and ovary	2
Sliding of appendix	2
Sliding of broad ligament	1
Direct	111
To include	
Sliding of cæcum	1
Sliding of sigmoid	4
Sliding of bladder	2
Direct and indirect	187
To include	
Sliding of sigmoid	5
Diverticulum of bladder	1

Bilateral

Indirect	131
To include	
Sliding of cæcum	1
Sliding of sigmoid	2
Direct	40
To include	
Sliding of sigmoid	3
Sliding of cæcum	1
Direct and indirect	34
Direct one side, indirect other side	12
To include	
Hernia of bladder	1
Direct and indirect one side, indirect other side	29
To include	
Sliding hernia of sigmoid	1
Direct and indirect one side, direct other side	14

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Complications: (Deaths not included—listed separately.)

Pulmonary:	
Bronchitis	32
Pneumonia	34
Cough	30
Influenza	1
Infarct	8
Embolism	1
Empyema	1
Pulmonary tuberculosis	5
Laryngitis	1
Skin:	
Dermatitis from skin preparation	6
Infective diseases	21
Infection of wound	70
(Some so slight as not to interfere with wound healing.)	
Testicle and epididymis:	
Epididymitis and orchitis	21
Spermatocele	1
Hydrocele	74
Varicocele	23
Hæmatoma	59
Accidents at operation:	
Vas cut and repaired	2
Bladder opened	2
Cord cut (testicle excised on left)	1
Sigmoid superficially nicked	1
Artery in meso torn—intra-abdominal hæmorrhage—operation through right rectus incision same day	1
Types of operation:	
(Note.—General anæsthetic—of recent years chiefly ethylene was used. In forty-one operations, local anæsthesia.)	

We note that the great majority of operations are performed in the typical fashion of Bassini, 1221 being so listed. Three hundred and thirty-five operations are listed as Bassini with some form of modification, the most important being the utilization of the transplanted rectus muscle or of the rectus sheath, or the omission of transplanting the cord, two hundred and thirteen cases being included in this particular group.

The transplantation of the muscle or sheath is done chiefly in cases of direct hernia or obviously imperfect musculature. Some of the other modifications are only a question of detail, as, for instance, the item, "Bassini plus conversion," which simply means that the existing indirect and direct sacs were converted into one and removed as one.

The next largest number, dignified by an author's name, is the Wylls Andrews, with one hundred and fifteen operations. Others are Stetten, with one hundred and eleven operations, the essential feature in this operation being the double overlap of the aponeurosis under the cord. We feel, how-

END-RESULTS INGUINAL HERNIA OPERATIONS

ever, that this and similar modifications are not of as great importance as the two capital underlying procedures; namely, the excision of the sac *or sacs* and the suitable reconstruction of the canal with the tissues in the plane posterior to the fascia. There were only two Gallie, thirty-seven Ferguson operations and fifty-seven Halsted. Our own feeling is that there is no essential difference between the Bassini and Halsted, for we do not believe that the suturing of the fascia of the external oblique under the cord adds materially to the strength of the canal providing the underlying procedures have been properly done.

Appendectomy.—The necessity or propriety of taking out the appendix through the right inguinal hernia opening is, of course, debatable, and some authorities condemn this procedure entirely. Other things being equal, we feel it is a justifiable procedure, providing it can be done with the maximum of care and gentleness. If the appendix and cæcum are not easily exposed we make no attempt unduly to drag them into the wound.

It is interesting to note that in several cases where we have abandoned the attempt to deliver the appendix, we have subsequently had to operate on these patients for an acute appendicitis, presumably the patients having a chronic appendix bound down to the surrounding tissues. Our figures show that in 1064 right-sided herniæ, 349 appendectomies were done (32 per cent.). Five of these were for acute appendicitis.

In our 1618 cases there were seventy infections, mostly trivial. Of these seventy infections, twenty-two were in cases where the appendix had been removed.

Résumé of Eight Deaths

1. W. P., age twenty-three, male. Right oblique inguinal hernia. Bassini operation. Infarct second post-operative day. Lung abscess. Thoracotomy. Died sixty-ninth post-operative day.
2. N. C., age fifty-two, male. Left oblique inguinal hernia plus sliding of sigmoid. Bassini operation plus rectus. Distension and pulmonary œdema—twenty-two hours post-operative died.
3. B. G., age forty-two, male. Right oblique inguinal hernia. Bassini cord not transplated. Died of heart failure twenty-third post-operative day. (Chronic myocarditis and phlebitis of left leg.)
4. H. R., age fourteen, male. Right oblique inguinal hernia. Bassini. Died fourth post-operative day. Bronchopneumonia.
5. S. K., age fifty-one, male. Right oblique inguinal hernia. Woolsey modification of Andrews. Died eighth post-operative day, of pulmonary embolism.
6. L. S., age fifty-five, male. Bilateral direct and indirect inguinal hernia. Bassini. Died ninth post-operative day of pulmonary embolism.
7. S. B., age forty-five, male. Left oblique inguinal hernia plus sliding. Stetten operation. Died third post-operative day of pulmonary embolism (fat?).
8. J. S., age fifty-one, male. Left direct and indirect inguinal hernia. Conversion Halsted under local. Died fourth post-operative day. Embolism.

The majority of deaths are due to pulmonary embolism and the average age for fatal cases is rather high. Patients over fifty should not be operated on indiscriminately.

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Résumé of Recurrent Hernia

1. J. L., age twenty-seven. Right oblique inguinal hernia. Bassini with appendectomy. Infected. Direct recurrence two and one-half years after operation. Second operation—Stetten. O.K. nine months later.
2. M. W., age twenty-five. Bilateral oblique inguinal hernia (sliding). Bassini with Hotchkiss right side; Bassini plus rectus on left side; appendectomy. Direct recurrence on right side at four months. Second operation—Bassini plus rectus. O.K. thirteen months later.
3. J. R., age six. Right oblique inguinal hernia. Bassini. Right direct recurrence which occurred before seven months. Second operation—Bassini with rectus. O.K. one year after operation.
4. F. L., age thirty-five. Bilateral direct inguinal hernia. Bassini plus rectus plus Stetten—both sides. Bilateral recurrence fourteen months. Second operation—Bassini with utilization of internal oblique and transversalis. O.K. two years later.
5. P. C., age forty-three. Bilateral oblique inguinal hernia. Bassini operation—both sides. Considerable cough during convalescence. Recurrence left side, lower end of wound, at four months. Refused operation.
6. M. G., age twenty-eight. Bilateral direct inguinal hernia. Right side Bassini plus rectus sheath; left side Bassini plus rectus muscle; appendectomy. Recurrence right side at nine months. No operation.
7. A. L., age twenty-five. Bilateral saddle-bag hernia (direct and indirect). Bassini with conversion of sacs on both sides. Direct recurrence on left side at eight months. Hernia came through hole in the rectus sheath. Second operation—Bassini plus transplantation of rectus sheath. Left hernia O.K. two years eight months. At that time right side had recurred (direct). Refused operation.
8. P. S., age thirty-four. Bilateral indirect inguinal hernia. Bassini plus rectus both sides. Recurrence left side—five months. (Letter so states—patient never seen).
9. W. O., age forty-four. Bilateral inguinal hernia—right saddle-bag; left direct. Bassini plus rectus with division of epigastrics, both sides; appendectomy. Both sides infected. Recurrence three months both sides. Operation at another hospital.
10. P. McG., age twenty-five. Bilateral indirect inguinal hernia. Bassini both sides; appendectomy. Left side recurred one year—direct sac. Second operation—Bassini. O.K. one year post-operative.
11. D. G., age forty. Right direct inguinal hernia. Bassini plus rectus plus division of epigastrics. Infection of wound. Recurrence—direct—at five months. Poupart's ligament had separated. Bassini plus rectus plus Halstead. Hernia recurred second time at end of one and one-half years. No operation.
12. J. P., age thirty-seven. Right direct inguinal hernia. Bassini plus rectus. Recurrence one year—direct. Second operation—under local—Bassini with utilization of internal oblique and transversalis. O.K. fifteen months post-operative.
13. M. M., age thirty-seven. Right indirect inguinal hernia. Bassini operation. Recurrence three months. No operation.
14. N. A., age fifty-one. Left saddle-bag hernia with sliding hernia of sigmoid. Bassini plus rectus transplant. Recurred at one year—direct. Second operation—Wylls Andrews with rectus transplant, cord being placed subcutaneous. O.K. five years four months later.
15. J. L., age twenty-nine. Bilateral indirect inguinal hernia. Bassini operation—both sides; appendectomy. Developed acute bronchitis post-operative. Left side recurrence—two months. No operation.
16. D. T., age forty-four. Bilateral direct inguinal hernia. Bassini plus rectus transplant. Both sides recurred—three months. No operation.
17. J. P., age 52. Right direct inguinal hernia. Bassini operation. Recurrence five months. No operation.

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18. J. S., age twenty-seven. Right direct inguinal hernia. Bassini with rectus transplant. Hernia probably recurred immediately—indirect. Bassini with transplantation of the cord. O.K. ten months post-operative.
19. S. B., age forty-nine. Bilateral—right direct; left saddle-bag. Bassini operation both sides—muscle very poor. Recurrence left side six months. Operated on at another hospital.
20. S. G., age twenty-three. Bilateral—right indirect; left saddle-bag. Bassini operation both sides. Right side recurred one month—indirect. Stetten operation. Right side recurred second time six months. No operation.
21. H. T., age sixty-five. Left saddle-bag hernia. Wyllys Andrews. Recurrence with small impulse at end of five months. No operation.
22. J. K., age thirty-two. Bilateral indirect, inguinal hernia. Bassini operation—both sides. Left side recurred—six months. No operation.
23. J. McL., age forty-two. Right direct inguinal hernia. Bassini; appendectomy. Recurrence four months. No operation.
24. G. C., age twenty. Left indirect inguinal hernia. Bassini operation. Recurred immediately (letter from patient—never seen).
25. W. C., age thirty. Bilateral—right direct with sliding hernia of bladder; left indirect. Bassini both sides. Left recurred at seven months. No operation.
26. F. P., age thirty-five. Right indirect and direct inguinal hernia. Bassini operation; appendectomy. Hernia recurred at four years—indirect. Stetten operation. O.K. nine months later.
27. H. W., age fifty. Bilateral—right direct and indirect; left direct with hernia of bladder. Bassini repair—both sides. Both sides recurred—five months. No operation.
28. M. S., age forty-one. Bilateral—left indirect; right direct. Bassini on both sides. Right side recurrent three years—indirect. Second operation—Stetten. O.K. nine months later.
29. A. S., age forty-four. Bilateral hernia—left direct; right indirect. Right side recurred—one year. No operation.
30. M. S., age thirty-six. Right indirect inguinal hernia. Bassini; appendectomy. Recurrence two years. No operation.
31. A. F., age twenty-eight. Bilateral indirect inguinal hernia. Bassini operation both sides. Bilateral recurrence—direct—two years. Second operation on private side. No follow up.
32. J. J., age forty-two. Bassini operation. Muscle very poor. Developed persistent cough. Hernia recurred ten days after operation. No operation.
33. A. K., age forty-five. Left direct inguinal hernia. Bassini plus rectus muscle. Recurrence six months. Direct through external ring. No operation.
34. W. O., age twenty-one. Right indirect and direct inguinal hernia. Bassini with conversion of sacs; appendectomy. Recurrence before three months. No operation.
35. J. M., age thirty-four. Left direct inguinal hernia. Bassini operation. Recurrence before nine months. No operation.
36. P. R., age fifty-five. Bilateral hernia—right indirect; left indirect and direct. Bassini operation right side; Bassini with division of epigastrics left side. Left side recurred before seven months. No operation.
37. N. M., age thirty-one. Right recurrent direct and indirect inguinal hernia (former operation in Italy). Halstead plus rectus transplant; appendectomy. Hernia recurred second time—three months. Direct Wyllys Andrews with ligation of vessels. Developed pneumonia with severe cellulitis. Hernia O.K. three months. Then returned to Italy.
38. V. U., age thirty-two. Left indirect inguinal hernia. Bassini operation. Recurrence five months. No operation.

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39. E. B., age twenty-two. Left indirect inguinal hernia. Bassini operation. Recurrence before four months. No operation.
40. R. B., age forty-eight. Bilateral direct and indirect inguinal hernia. Bassini repair both sides; appendectomy. Recurrence left side before three months. No operation.
41. L. S., age thirty-five. Bilateral indirect inguinal hernia. Bassini operation—both sides. Recurrence five months—right side. No operation.
42. N. N., age forty. Right indirect inguinal hernia. Bassini operation. Local anæsthesia. Developed acute bronchitis. Recurrence before seven months. No operation.
43. J. K., age thirty-one. Right indirect inguinal hernia. Bassini operation. Recurrence nine months. No operation.
44. M. K., age thirty-seven. Left indirect inguinal hernia. Bassini operation. Recurrence before eleven months. No operation.
45. F. Z., age sixty-three. Right direct and indirect inguinal hernia. Wyllys Andrews plus rectus sheath transant. Hernia recurred fourteen months. Direct. Second operation—Gallie. O.K. ninth months—post-operative.
46. S. C., age forty-nine. Bilateral—left indirect; right direct and indirect. Left side Wyllys Andrews; right side Stetten plus rectus muscle and sheath. Right side recurred before four months. Indirect. Second operation—Stetten. Recurrence seven months later. No operation.
47. A. M., age twenty-eight. Right indirect inguinal hernia (congenital type). Bassini operation. Recurrence before three months. No operation.
48. F. B., age thirty-nine. Bilateral direct inguinal hernia. Halsted operation—both sides. Developed persistent cough after operation. Recurrence right side before sixteen months. No operation.

Summary of Recurrences

Total no. of cases.....	48
Bilateral (all done at one sitting).....	23

Types of Hernia Which Recurred

One side

	Indirect.....	12
	Direct.....	7
13	Direct recurrent (first operation at another hospital)...	1
Direct	Indirect and direct.....	4
	Indirect and direct (plus sliding of sigmoid).....	1

Bilateral

	Indirect.....	7
	Indirect plus sliding.....	1
	Direct.....	4
	Direct and indirect.....	2
	Direct and indirect one side, indirect other.....	3
	Direct and indirect one side, direct other.....	2
15	Right side direct with sliding hernia of bladder, left indirect.....	1
Direct	Right direct and indirect, left direct with hernia of bladder.....	1
	Indirect one side, direct other.....	2

END-RESULTS INGUINAL HERNIA OPERATIONS

Time of Recurrence:

Immediately.....	3	} 35 cases nine months or under (72.9 per cent.)
1 month.....	1	
2 months.....	1	
3 months.....	7	
4 months.....	5	
5 months.....	7	
6 months.....	3	
7 months.....	4	
8 months.....	1	
9 months.....	3	

Average time of nine-months period, 4.6 months

11 months.....	1	} 13 cases over 9 months (27.1 per cent.)
14 months.....	2	
16 months.....	1	
1 year.....	4	
2 years.....	2	
2½ years.....	1	
3 years.....	1	
4 years.....	1	

Of the 427 direct herniæ, 28 recurred (6.5 per cent.). Of the 1451 indirect herniæ, 20 recurred (1.3 per cent.). Of the single herniæ, 1618 cases, 25 recurred (1.5 per cent.). Of the bilateral herniæ, 260 cases, 23 recurred (8.9 per cent.). Of the 48 recurrences 17 were re-operated on.

There is a difference of opinion as to whether bilateral operations should be done in one or two sittings. On the whole we believe that doing a bilateral operation at one sitting increases the possibility of recurrence, as twenty-three of our total forty-eight recurrences were bilateral herniæ done at one sitting.

The critical reader will at once remark, and very properly, that our figures have relatively little value in that the time of observation in many cases is not sufficiently prolonged. Our normal procedure is to notify the patient on his discharge that he will be asked to return in three months, and to return at any time if he has trouble. This admonition, we believe, is of value and has resulted, as noted in the above figures, in the return of patients some times over many years.

Knowing that we many expect more trouble with the direct hernia, patients are requested to return at the end of nine months. We have chosen nine months because if we leave it for a year with the shifting population we are likely to lose a considerable number of cases. We believe, however, that even with this acknowledged deficiency we have a fairly reliable picture of the status of valid results as 72.9 per cent. of our recurrences recurred within the nine-months period, the average time for that period being 4.6 months.

We call particular attention to the marked difference in the results between direct and indirect hernia, and also the preponderance of recurrence in bilateral cases.

Direct herniæ.—For many years we have been impressed with the necessity

for more thorough operations on direct herniæ. It is particularly important to recognize that there is a direct hernial sac and to exhaust every possibility to demonstrate and exsect it. Even relatively large direct herniæ may not show an obvious sac at the time of operation until it is clearly demonstrated by painstaking dissection. One of the simplest methods of demonstrating a direct sac is to isolate and expose the indirect sac and pass the finger downward into the canal where it will readily cause the direct hernia to protrude. The failure to look for and establish the presence of a direct sac in an obvious indirect sac, is perhaps the most frequent cause of failure to cure a direct hernia, for we believe that the cure of a hernia lies in the recognition and exsection of *all sacs*.

The dissection of the direct sac is sometimes tedious; but it must be thorough and it is in these operations for direct hernia that there is a possibility of trauma to the bladder. In addition to the proper handling of the sac it is important to utilize proper anatomical structures for the perfect closure of the canal, for it is in these cases where the so-called conjoined tendon is valueless as material.

Our preference is to make an incision at the anterior outer edge of the sheath of the rectus, passing interrupted chromic catgut sutures through the presenting edge of the rectus muscle and through the deepest layer of Poupart's and Gimbernat's ligament. As additional security, the mesial cut edge of the sheath of the rectus is similarly sutured superior to the first layer. It is important to use the mesial edge, for the outer edge is valueless, as it frays out.

GENERAL CONSIDERATIONS.—Operations for inguinal hernia are generally satisfactory, both as regards cure and danger to life and relative freedom from complications. There still exists room for improvement. The mortality would be negligible but for the incidence of pulmonary embolism, a still unsolved problem.*

Who should be operated on?—Practically all young and healthy individuals. Very young children can usually wait as they are not very apt to develop accidents. Individuals past fifty, the class most prone to a higher mortality and percentage of failures to cure, should ordinarily not be operated on except for definite indications, unusual discomforts, disability and strangulation.

Source of failures.—The greatest single factor is the sac. If easily identified and radically dealt with, as in indirect hernia, the results are good. Direct hernia is a different and special problem. Sacs are overlooked and improperly handled and, in addition, special forms of closure, such as transplantation of the rectus, are necessary, also longer stay in bed.

The highest incidence of recurrence, bilateral hernia operated on at one sitting, is disturbing and we must seek for improved results. The operation

* Sufferers from hernia sometimes die from embolism without undergoing operation.

END-RESULTS INGUINAL HERNIA OPERATION

may be prolonged and possibly fatiguing and its details not so accurately executed.

It is our practice usually to do difficult and extensive double herniæ, particularly the direct, in two stages.

If an insufficient operation has been done, the failure promptly becomes evident, 72.9 per cent. of recurrences being within nine months.

Our records show only two instances of the Gallie operation. We doubt if this operation is an improvement over current methods. We are influenced by our gratifying results in extensive abdominal herniæ, where we only utilize the various structures of the abdominal wall.¹

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SLIDING HERNIAS OF THE ASCENDING COLON AND CÆCUM, THE DESCENDING COLON AND SIGMOID, AND OF THE BLADDER

BY ARTHUR DEAN BEVAN, M.D.

OF CHICAGO, ILL.

A FEW months ago while I was doing an operation for radical cure of a left inguinal hernia, on one of my colleagues, I found that I had to deal with a sliding hernia of the descending colon and sigmoid. I did the operation under local anæsthesia. I took the occasion to quiz some of my assistants and

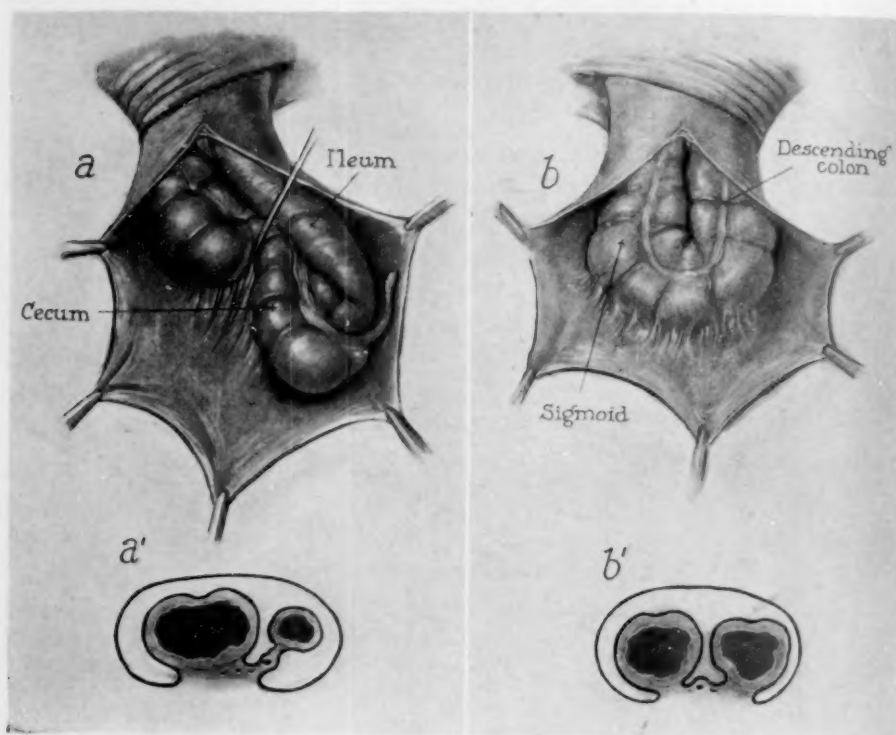


FIG. 1.—Cross sections of sliding hernia of the cæcum and ascending colon.

FIG. 2.—Cross section of sliding hernia of the descending colon and sigmoid.

younger surgical colleagues and found that their conception of sliding hernias and the proper methods of operating upon them was rather vague.

This experience made me feel that it might be well worth while to again review this subject and present a method of operation which I have employed in a number of cases and found to be exceedingly satisfactory. I have found in my own work three different forms of sliding hernia: first, the sliding hernia of the cæcum and ascending colon; second, the sliding hernia of

ANATOMY AND OPERATIVE TECHNIC OF SLIDING HERNIAS

the sigmoid and descending colon; and third, the sliding hernia of the bladder.

An English surgeon, Albert J. Walton, of London, has an excellent article on Extrasaccular or Sliding Hernia in the *ANNALS OF SURGERY*, Vol. lvii, p. 86, 1913. He very well defines the condition as follows:

"Extrasaccular or sliding hernia is one in which some portion of the wall is formed by a viscus which in its normal position is only in part covered by peritoneum. It is thus seen that this viscus in the inguinal or femoral region may be either bladder, cæcum and ascending colon or iliac, i.e., descending colon and sigmoid." (See Figs. 1 and 2.)

I can remember very well the first case that I operated on of sliding hernia of the cæcum and ascending colon. It was more than thirty years ago. I operated on a good-sized inguinal hernia of the right side. When I opened the large sac I found that the cæcum and ascending colon were apparently adherent to the posterior portion of the sac. I proceeded to

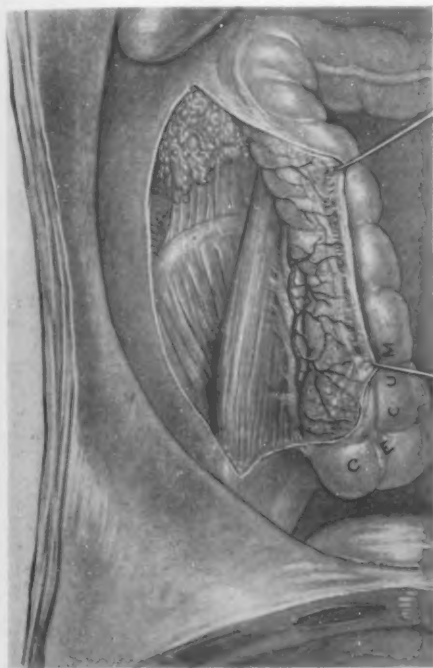


FIG. 3.—Showing blood supply and the method of mobilizing the cæcum and ascending colon within the abdominal cavity in resecting the colon for carcinoma and other lesions.

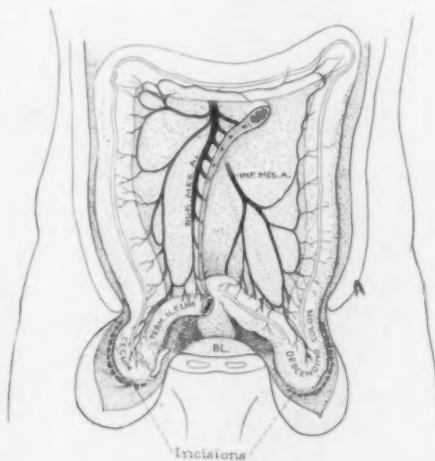


FIG. 4.—Showing blood supply of sliding hernias of cæcum and ascending colon and of the descending colon and sigmoid, and incision necessary to safely mobilize the bowel in the hernia sac by dividing the outer avascular layer of the mesocolon.

separate what I regarded as adhesions and I then found that I was dividing the mesentery of the cæcum. Fortunately, I did not damage the vessels of the gut sufficiently to cut off the blood supply. I did, however, divide the mesentery and peritoneum sufficiently to enable me to return the bowel into the peritoneal cavity and then closed the hernial sac with a catgut suture and repaired the hernia by the Bassini method, fortunately obtaining a cure. I then reviewed the literature and obtained a fair conception of the condition. Gradually in my clinic I accumulated a considerable experience with the

various forms of sliding hernia so that I was able to master the problem when it occurred unexpectedly, as it almost always does, for I cannot remember making a diagnosis of this condition before the operation.

It is very necessary to have a thorough anatomy involved in these sliding hernias in order to operate upon them safely and successfully. It is well known to abdominal surgeons that the entire colon except the rectum can be mobilized by dividing the outer layer of the

mesocolon; the outer layer is avascular; it contains no blood-vessels. We take advantage of this fact when we resect the cæcum and ascending colon, or the descending colon and sigmoid, or, in fact, any part of the colon except the rectum. The blood-vessels of the colon come from the inner side. Keep this fact in mind in handling sliding hernias of the cæcum and ascending colon on the right side and hernias of the descending colon and sigmoid on the left. See Figs. 3 and 4 of the blood supply.

The technic which I desire to present has been a matter of gradual development in my hernia work and covers probably a period of twenty years. This technic was first employed in operations on direct inguinal hernias. I found in operating on these cases of direct hernia that, as a rule,

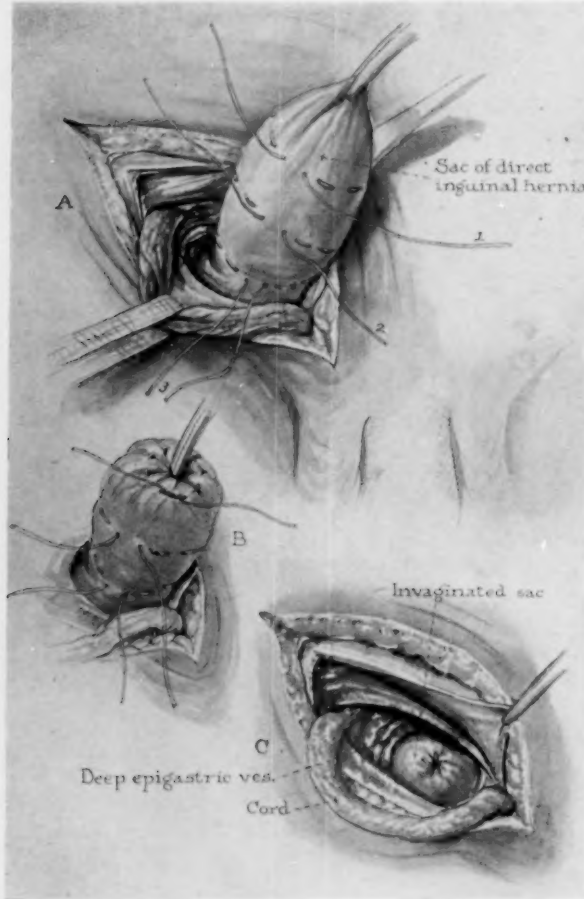


FIG. 5.—Invagination method of treating the sac in direct hernia and method to be employed in sliding hernia of the bladder, and moderate size sliding hernia of the colon.

the sac could not be isolated in the same clean-cut way that it can be in the indirect inguinal hernia. The mouth of the sac is often wide, sometimes very wide, and the closure by transfixion and ligation is not nearly as satisfactory as in the indirect hernia. I began to look for a better method of dealing with these sacs and I found it in the method of invaginating the sac into the peritoneal cavity with two or three or even four purse-string sutures of rather

ANATOMY AND OPERATIVE TECHNIC OF SLIDING HERNIAS

durable catgut. This method secures a fine closure of the peritoneal sac of a hernia. The peritoneum lends itself well to such a method of obliterating the sac permanently by the plastic reparative peritonitis which this invagination by purse-string sutures produces. (See Fig. 5.)

In doing a large number of direct hernias by this method, I employed it in a number of cases of direct hernia which involved the bladder wall,

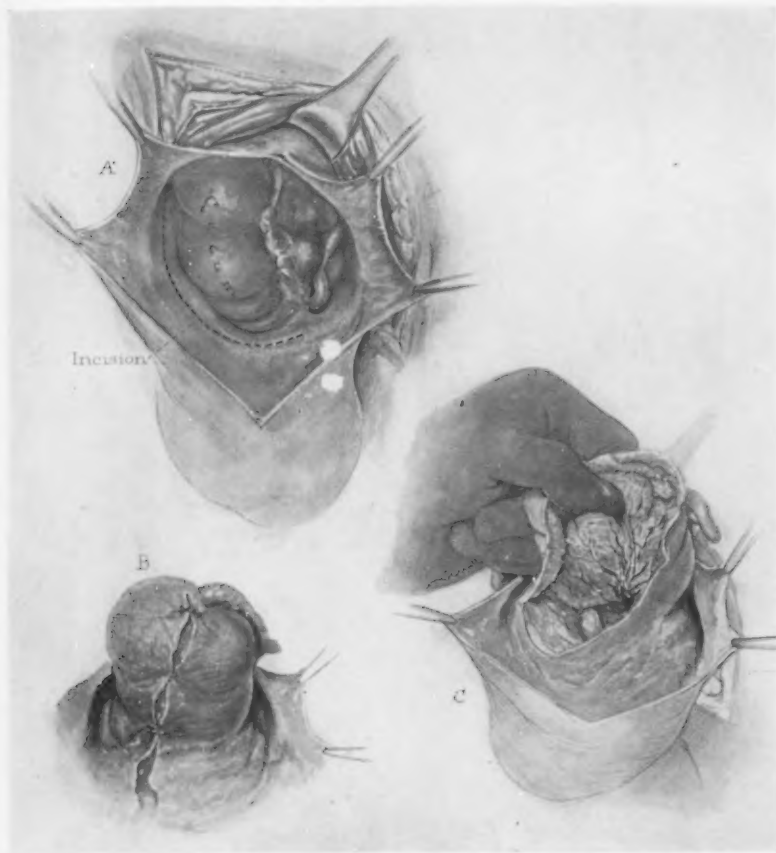


FIG. 6.—Technic of operation for large sliding hernia of the cecum and ascending colon: First, opening the sac freely along the anterior surface; Second, mobilizing the bowel by dividing the outer layer of the mesocolon, gently replacing the bowel into the peritoneal cavity.

the sliding hernia of the bladder, and I found that it was the simplest and best method that I had ever used for sliding hernia of the bladder.

Later I began to employ this method in sliding hernias of the cecum and ascending colon and of the descending colon and the sigmoid and found that it was the simplest and best method in these sliding hernias of the large intestine, except sliding hernias of large size. In these the invagination method with purse-string sutures of catgut can be used as a part of the technic, but in the large sliding hernias with a large segment of colon in the sac it may be necessary to employ a special technic to mobilize

the colon so that it can be returned into the peritoneal cavity without any injury to its blood supply (see Figs. 6 and 7); in very large sacs it may be better to remove a large part of the sac and then invaginate the rest by the purse-string suture method. The surgeon who is operating on a good many

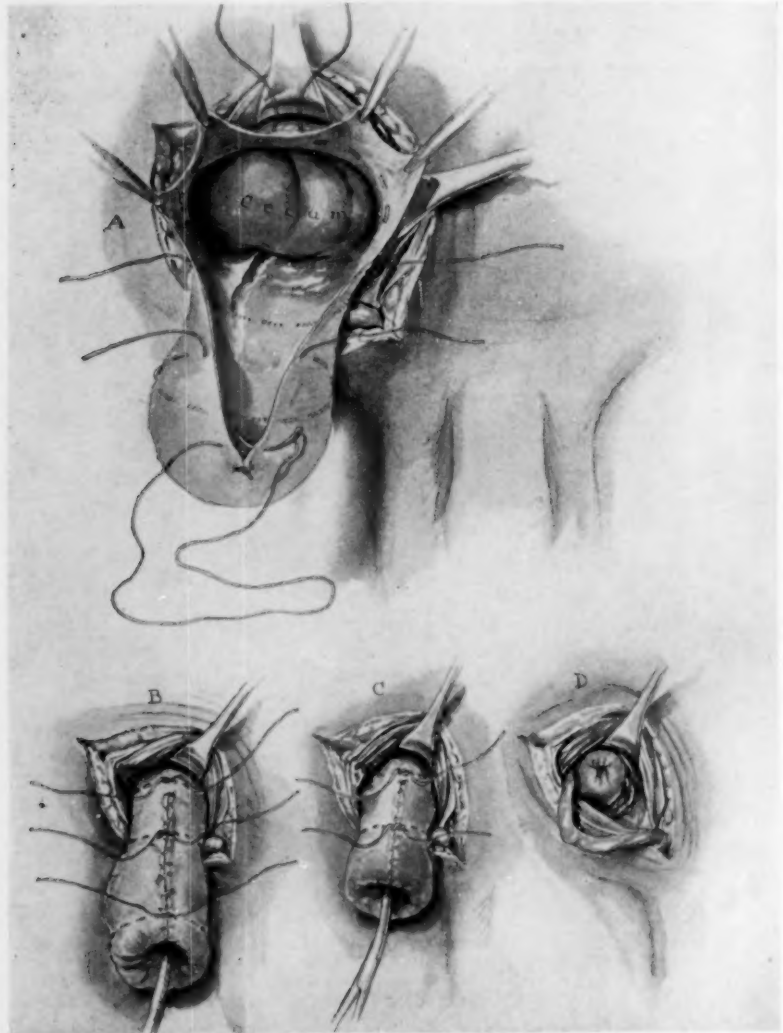


FIG. 7.—Third, introducing three purse-string sutures while the sac is still open; Fourth, sew up the incision in the anterior surface of the sac and invaginate the sac with three purse-string sutures into the peritoneal cavity. In very large sliding hernias with very large sacs the excess portion of the sac should be removed and the balance invaginated as described.

hernias will run up against many sliding hernias of the colon and bladder, and it will be well for him to be prepared to meet these difficult problems. Sliding hernias occur in about 1 per cent. of hernia operations.

This technic will appear clearer by a careful study of the series of plates shown.

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It has now been amply proven both by clinical work and by work in the experimental surgical laboratory on dogs that the strength of the closure in inguinal hernia depends upon the proper closure of the external oblique aponeurosis. This is the strong structure which withstands intra-abdominal pressure. The union of fascia to fascia is much stronger than that of muscle to fascia. (See Fig. 8.)

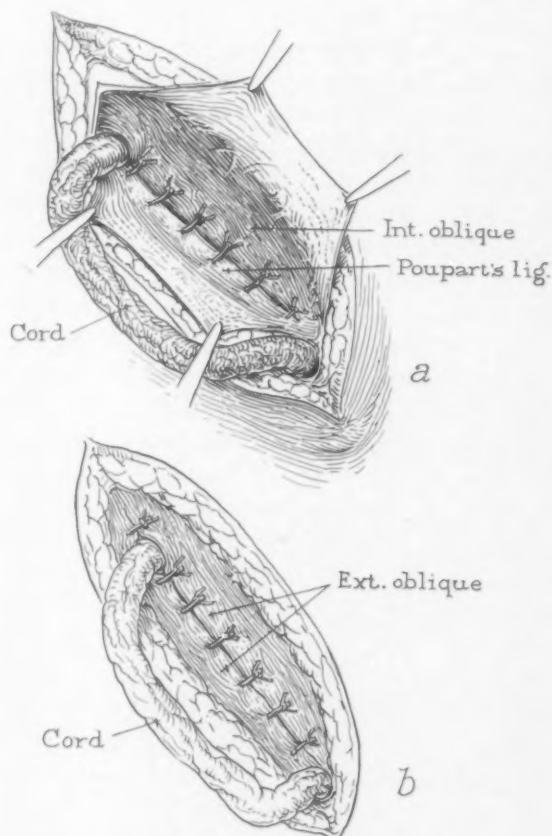


FIG. 8.—Fifth, close the canal by the only sound method of doing an inguinal hernia which is as follows: Elevate the cord as in the Bassini operation; close the canal with first a continuous suture, which brings the conjoint tendon to the shelf of Poupart's ligament, and a second continuous suture which brings the edge of Poupart's and the inner edge of the external oblique accurately together with the cord still elevated. The cord is now covered with the superficial fat by running sutures of fine catgut which sews together the deep layer of the superficial fascia.

I have felt that the importance of the anatomic and surgical principles involved in this rather rare and difficult problem of sliding hernia and the results which have been obtained by the operation which I have developed warrant my presenting this subject to you.

The method of Dr. Moschowitz necessitates a laparotomy. He thought it could be eliminated. Invagination with two or three purse string sutures works admirably, because as one invaginates the first suture, one apparently

DISCUSSION

simply pushes back a part of the sac, let us say a third. As one does the second, one has two-thirds of it back. As one does the third suture, introduced right under one's eye, it brings the peritoneum snugly up well inside the internal ring. That is the secret with it, that is the ease with which the three purse string sutures enable one gradually to push back the colon and retain it back in position. It is very desirable not to complicate the operation with a laparotomy. He was quite converted to the position that the one way of doing an inguinal hernia to give the patient the best prospect of cure and the least prospect of recurrence is the suture of the external oblique under the cord. The work of Seelig in the laboratory shows that the sewing of the conjoined tendon of muscle to fascia gives very little strength, that what one requires is a drumhead, a firm drumhead that does not yield, and this is obtained by a closure of the external oblique to the edge of Poupart's that extends up from the angle at the symphysis to the internal ring. Nothing comes out at the internal ring except the cord. What one needs most of all is this absolute closure from the angle to the internal ring. That can certainly be better brought about by uniting the external oblique to the edge of Poupart's which we no longer imbricate as a rule; it is important not to imbricate it if in doing so one puts the structure on tension. One should have plenty of the external oblique in order to imbricate.

The clinical evidence is this: surgeons have cured repeatedly, especially in direct herniæ, recurrences by this method where the ordinary methods have failed. That is not in one case but in a great many cases cure has been secured permanently in direct herniæ that have recurred after operation.

UROSELECTAN INTRAVENOUS UROGRAPHY

BY EDWIN BEER, M.D.

OF NEW YORK, N. Y.

THE retrograde introduction of radiopaque materials, particularly radiopaque solutions into the urinary organs, has led to a most remarkable improvement in diagnostic accuracy. The development in the interpretation of the pictures obtained has been unusually rapid and complete. In 1923, Osborne, Sutherland, Scholl and Rowntree made more or less successful attempts to avoid the usual retrograde method by administering iodides intravenously and by mouth. Added stimulus was given to these researches by Graham's successful work on the gall-bladder visualization. Rosenstein, von Lichtenberg, Volkmann, Lenardouzzi, Pecco, Hryntschak and Roseno have contributed to these investigations, but it remained for M. Swick¹ to finally solve this difficult and most important problem.

After working with selectan neutral, synthesized by Professor Binz and Doctor Raeth, on the Medical Service of Professor Lichtwitz in Altona, Germany, and failing to obtain satisfactory results with any regularity, a new preparation was tried by him without the methyl group (which may have been responsible for mild toxic symptoms, including double vision) and this new preparation is the uroselectan that is being used at present. Uroselectan is non-toxic, very soluble in water and it is excreted under normal conditions almost completely within eight hours, producing no irritation in the urinary tract. It is administered slowly intravenously in doses of forty to sixty grams² (less in children) and exposures are made beginning fifteen minutes after the injection. As the intensity of the shadows obtained varies with the function of the kidneys, uroselectan is proving to be a test of renal function. In its passage through the kidney, it intensifies the kidney outline and as it is excreted into the pelvis it fills the calices and pelvis, as well as the ureter and the bladder—all of which are readily visualized on the röntgen film.

Without going into extensive details as to the nature of the drug, the exact method of its administration, the estimation of the amount excreted which also gives us a new functional test, the use of air compression to produce more intense pictures and the administration of divided or double doses, some of which points Swick has partly described in brief in his last publication³ and will shortly publish in greater detail, I would like to call attention to the possibilities of this method.

We have been particularly fortunate in our studies with uroselectan to have Doctor Swick attached to my service since his return from Europe, and he has, with the coöperation of the Mount Sinai Hospital X-ray Department, as well as with the office equipment, demonstrated to my satisfaction the great value of his method. Whether this preparation will be improved upon,

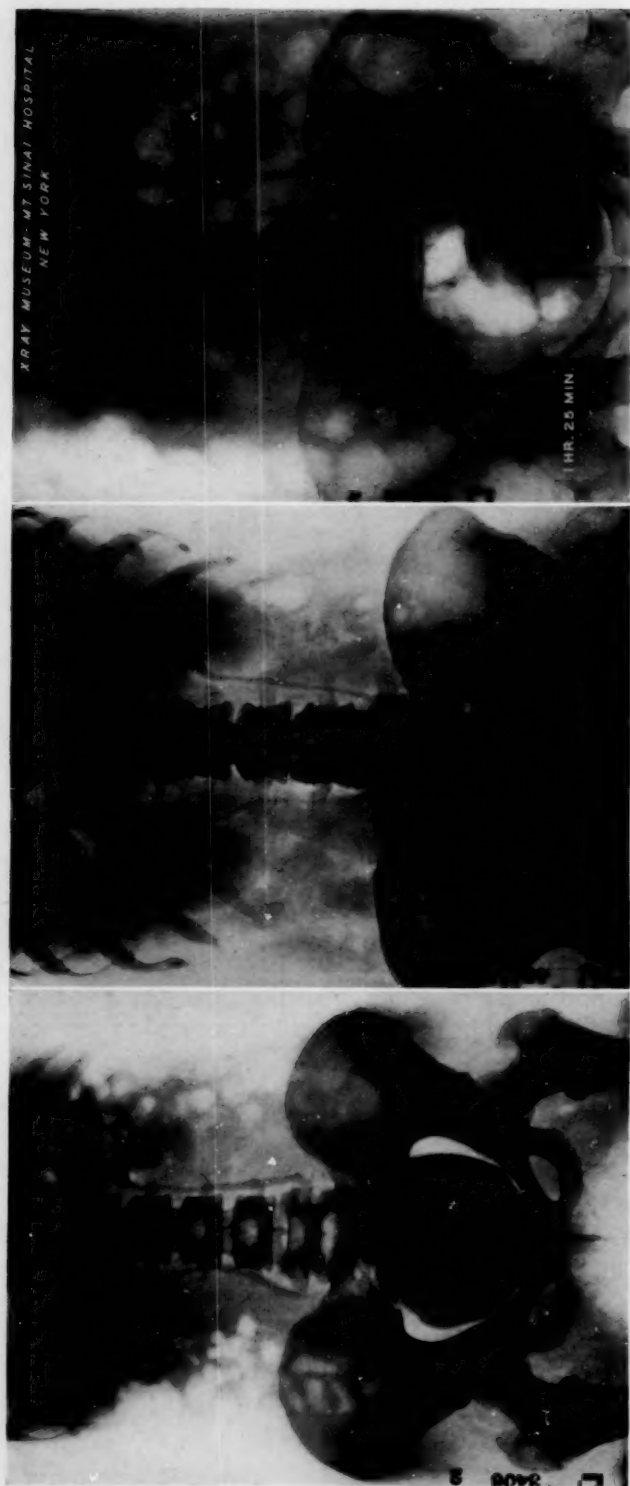


FIG. 1.—M. H., child of thirteen years, who may have had pyelitis. Intravenous urography outlines kidneys and almost normal pelvis. Ureters are completely filled, almost to bladder and bladder shadow shows almost symmetrical organ.

FIG. 2.—J. M., female. Suspected of having uric acid stone. Repeated examination was negative. Intravenous examination shows normal contour of kidneys, which are very distinctly intensified, normal pelvis with slightest dilatation on the right side. Ureters distinctly filled, and the bladder clearly outlined, of normal contour.

FIG. 3.—E., male. Resection of bladder for cancer, transplantation of left ureter. Intravenous urography shows both kidneys are functioning, slight hydronephrosis, hydroureter on the side of the transplanted ureter and there is some deformity in the bladder outline where the bladder was resected.

UROSELECTAN INTRAVENOUS UROGRAPHY



FIG. 4.—P., child. Extrophy of bladder. Bilateral transplanation of ureters into sigmoid. Intravenous urography shows slightly dilated ureters and pelvis, involving calices. Ureters can be traced well down in some of the pictures, and the rectum is filled with some of the opaque material.



FIG. 5.—S., adult male. Prostatic obstruction. Intravenous urography shows marked dilatation, especially of left pelvis, upper ureter and calices. Ureters on both sides clearly outlined and in the lumbar region a very marked ureteral kink. Large bladder is clearly filled. In this patient, cystogram from below showed reflux up both ureters and practically the same picture as the intravenous urogram.

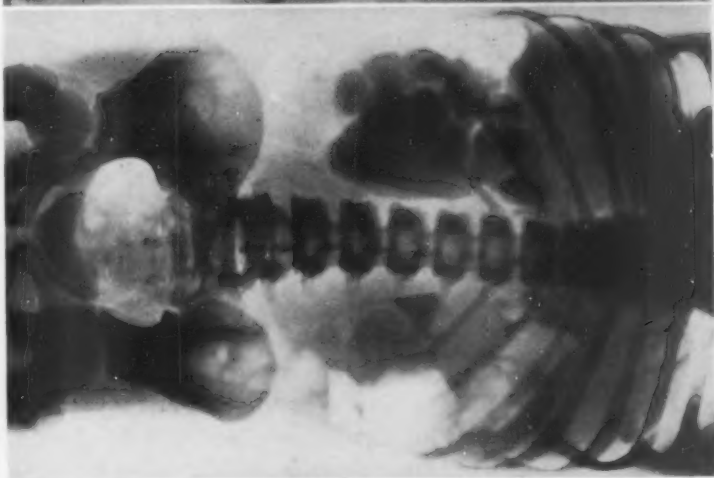


FIG. 6.—A., child. Left kidney enlargement. Intravenous urogram shows large hydronephrotic left kidney, large pelvis and dilated calices. On the right side at this exposure the normal pelvis is almost empty.

whether per oral urography with other drugs will be a further development in this field, remains to be seen.

It has been suggested that this new method will do away with retrograde urography and perhaps allow the profession to dispense with the cystoscopic examination. This, I believe, is a hasty conclusion and not warranted by the facts as I see them. I am convinced that the more or less routine use of uroselectan urography is surely going to discover pathology in the urinary tract which now is unnoticed except by the patient. Separation of kidney specimens, visualization of the interior of the bladder, pyelo-ureterography to confirm the findings made with uroselectan will be more frequently necessary in the future than in the past, when medical practitioners, general surgeons, gynecologists and urologists insist on a preliminary uroselectan urography as a more or less routine procedure.

Intravenous urography will be of great use in children in whom cystoscopic procedures may require complete anaesthesia, as well as in patients who are intolerant, either because of local pathology or because of their mental make-up. In badly diseased bladders, where one or both ureters cannot be located or entered far enough to obtain a retrograde pyelogram, it will and does prove of supreme assistance. In cases in which the ureters have been transplanted into the bladder, as after a resection, or into the sigmoid, uroselectan urography alone can give us an adequate picture of the transplanted ureter, pelvis and kidney. At the same time, it gives us a fair idea of the transplant's function.

In a study of eighty-four urological cases published by von Lichtenberg and Swick,⁴ sixty-one cases, or 75 per cent., gave satisfactory diagnostic data. Our experience confirms their experience, that excellent shadows are obtained in normal patients, as well as in incomplete obstructive conditions, such as hydronephrosis, ureter and kidney stones, provided renal function is adequate. If no shadow is obtained, either there is no kidney or the organ is almost functionless. Function may also be inadequate in bilateral obstruction, as in prostates, in renal tumors and pyonephroses.

The interpretation of the pictures obtained with uroselectan requires some experience as their clarity varies with the kidney function. In retrograde urography, the urinary tract is filled from below and at times distorted pictures are produced by distention or over-distention. Naturally, this does not happen with intravenous urography, and in studying the pictures obtained, one has to be reeducated to some extent. The sharp pictures that we have been accustomed to are less frequently obtained with the intravenous method, even though as a rule very adequate delineation of the upper tract can be seen, provided always that the excretory activity of the kidneys is not greatly reduced.

From these brief remarks, it must be evident that with intravenous urography many unsuspected lesions in the urinary tract will be readily discovered and all sorts of new viewpoints will be developed, which will clarify and elucidate hitherto unsuspected phases of urinary pathology.

UROSELECTAN INTRAVENOUS UROGRAPHY

The reproductions shown were made from films taken of patients injected by the Swick method with intravenous uroselectan by Doctor Swick.

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DISCUSSION: DR. WILLIAM E. LOWER, of Cleveland, had tried out this method of diagnosis to a very limited extent and was able to confirm what Dr. Beer had so graphically shown. There is one question that must be considered, and that is how accurate this is going to be as a functional test. Until we can check it up against the other functional tests we must reserve our opinion as to its usefulness in that way, but as a method for outlining the kidneys and as a method for aiding in diagnosis in cases in which one is unable to do a ureteral catheterization, it is a wonderful advance. He thought it one of the greatest aids that have occurred in Urology in a long time.

COCCUS INFECTIONS OF THE KIDNEY

THEIR FREQUENCY AND THEIR RELATION TO THE UPPER RESPIRATORY TRACT

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AS LONG ago as 1889, Albaran clearly recognized this type of renal infection, pointed out its hæmatogenous origin, described its frequent involvement of the glomerular structures, its tendency to form multiple abscesses, perinephritic abscesses, etc. He believed that trauma to the kidney was an important factor. It is next interesting to recall that George Brewer, a member of this Association, in communications in 1911, 1913, and 1915, clearly drew the picture of the more severe infections, and drew attention sharply to their importance. There is, of course, an enormous literature which it would be futile to attempt to summarize. We call attention, however, particularly to the work of Helmholtz and Milliken, Bumpus and Meissner, and Rosenow, whose contributions have been made, as I think, basic in this study.

In this paper we wish particularly to call attention to the frequency of this type of infection, to certain points in its etiology, to certain, as we think, helpful methods of diagnosis, and to suggest a possible sequential relationship between these acute infections with pus-producing cocci and the much more chronic infections believed to be caused by the colon bacillus group.

Frequency.—Most writers on this subject have been chiefly concerned with the more severe types of infection, though several have drawn attention to the occurrence of milder forms in which, however, they generally found the diagnosis difficult. Using a method of diagnosis later to be described, we have come to the conclusion that these milder degrees of infection are not only uncommon but are probably very common. During the last two years at the University Hospital, we have encountered over forty cases, of which we have satisfactory records of twenty-seven. We shrewdly suspect that these infections frequently occur as complications of infections of the upper respiratory tract, of septic wounds and of cutaneous infections of various kinds and are commonly charged off to the infections when, in fact, the increased fever, *etc.*, is of renal origin. Cases III, IV, VI, X, XII, XIII, XIV, XV, XVI, XVII, might easily have been charged off to the primary infection had attention not been focused upon the possibility of this renal complication.

Etiology.—Although it has long been recognized that bacteria from a local inflammation may frequently enter the blood, and though, of course, such bacteria, if they survive, must undoubtedly reach the kidneys, the full significance of this has not perhaps been sufficiently clear. On this point a recent article by Scott¹ is important. Studying a large group of urological cases on the service of Dr. H. H. Young during a period of two years, he obtained

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positive evidence of blood-stream infections in eighty-two different cases, 62 per cent. of these cases following operation. Of the positive blood cultures, 77 per cent. were bacillary and 23 per cent. were coccal infections of the blood-stream. This communication seems to me important as showing the relative frequency of blood-stream infections, the chief evidence of which was transitory febrile reactions.

Attention has frequently been called to the apparent association of so-called pyelitis in children with infections of the upper respiratory tract. The difficulty in regarding them as directly related has been that the organisms infecting the upper respiratory tract were practically always various forms of cocci while the organisms found in the urine were, in the great majority of cases, bacilli of the colon bacillus group. In our series of cases, there occurred seven in which the relationship between the respiratory infection and the infection of the kidney seemed quite clear. In at least one of this group, XV, which ran a rather longer course, bacilli appeared in the urine some time later in convalescence. In several of the other cases, notably III, VIII, XVIII, and XIX, the early pure coccus infection was succeeded by a mixture with colon bacilli. This observation appears to us to throw some light upon the suggestion previously made by many other observers, that the very large percentages of kidney infections showing colon bacilli, at least in the later stages, represents an unduly large proportion of the cases in which this organism is the original malefactor. It tends to accentuate the opinion previously expressed by many observers that the colon bacillus group may be chiefly a relatively late interloper which overgrows the original infection and finally takes possession of the field. It suggests that the original infection may be much more commonly with the coccus than we have supposed and that we should look to this as the original source of insult to the kidney leading to the later condition which we rather roughly classify as pyelitis.

To two cases in this group we wish to call particular attention. We have for years been familiar with the rather vague clinical entity described as defloration cystitis. Personally, we have long believed that the element of cystitis was but a symptom of a renal infection due to organisms entering the circulation through various hymenal tears. Cases I and II tend to support the view that these infections are blood-stream infections, affecting the kidney primarily and that at least in some cases the coccus is the primary infecting organism.

Diagnosis.—It has long been recognized that in this group of renal infections, the urine showed but the slightest evidences of abnormality and the diagnosis had therefore to be made largely upon physical examination showing tenderness over the kidney, importantly in the costo-muscular angle, enlargement of the kidney and evidence of perinephritis. Many years ago in a paper with Crabtree, we called attention to the fact that a scrupulous examination of the urine in these patients would commonly show cocci in numbers so great as to bar the possibility of contamination. This method has now become our main reliance in diagnosis and we depend chiefly upon the results of

smears taken from the often apparently normal urine which has been highly centrifugalized, using only very fresh specimens and only specimens obtained by catheter in the case of female patients. Stained specimens taken from the very moderate sediment obtained by means of the prolonged use of the high-speed centrifuge, will almost always show cocci in large numbers, sufficient, as we believe, to justify the diagnosis.

As was pointed out by various observers in the past, these organisms are most commonly found in the early days of the condition. To this observation, we add the fact that they may not appear for a few days after the onset, at which time they may be found in large numbers. A further observation originally made, I think, by Crabtree, is that in a fair proportion of the cases, though the stain was satisfactorily taken, the organisms will not always grow satisfactorily upon ordinary culture medium. This may very likely be due to our unskillful bacteriological technique. However, the method of study of centrifuged specimens by stain seems to us clinically satisfactory and can, we believe, be depended upon for accurate diagnosis with greater certainty than by culture. The finding of cocci in large numbers in the urine, coupled with the clinical picture of moderate renal infection, is, we think, sufficient to establish the diagnosis.

Course of the disease.—A study of the appended cases will clearly show that the condition in many cases runs a short course, ending in complete recovery, except insofar as there are undoubted lesions of the glomeruli which, however, are probably not of importance to the renal function. We shrewdly suspect that if these cases are carefully watched for, we should come to the conclusion that these coccus infections of the kidney are common and generally of a mild type. A few of our cases, on the other hand, must be classified as belonging to the subacute group, particularly XIX, XXII, XXVI, and XXVII. Case XXV belongs to the acute group, perhaps best known to the surgeon. With increasing experience, we become more conservative in the management of these cases and have seen in the last few years, several in which we should ten years ago have unhesitatingly advised operation but in which a Fabian policy has resulted in recovery. Surprisingly serious infections of the kidney of this type will recover without operation.

Finally, we again call attention to the very intimate relation between this lesion of the kidney and perinephritic abscess. We believe it constitutes the etiological factor in the overwhelming majority of cases and that perinephritic abscess should always be suspected when these lesions fail to run a satisfactory course within a reasonable period.

Brief abstracts of the cases are appended in order to show the nature of the evidence.

ETIOLOGY KNOWN

CASE I.—Female, aged nineteen years. *Etiology.*—Defloration eighteen hours before present illness.

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Symptoms.—Abrupt onset, chill, fever to 105°, RCV pain, tenderness, spasm, right renal colic, frequency and burning on urination. *Duration.*—Pain and tenderness, ten days; fever, eight days; frequency and burning, fourteen days.

Laboratory findings.—White blood cells 18,000; urine 100 red blood cells and loaded with cocci. Urine became entirely normal in twenty-one days.

Result.—Excellent. Patient has since had normal pregnancy without "pyelitis of pregnancy."

CASE II.—127886, female, aged twenty-eight years. *Etiology.*—defloration twenty-four hours before present illness.

Symptoms.—Sudden onset, chill, fever, dysuria, frequency and burning. Seen one week following onset. Physical findings normal. *Cystoscopy.*—Bladder showed blotchy inflammation. Left ureter specimen negative; right white blood cells, cocci, bacilli.

Laboratory findings.—Urine, 50 white blood cells, cocci and bacilli.

Result.—Symptoms and signs all cleared in two months.

CASE III.—220733, female, aged fifty-five years. *Etiology.*—Chronic empyema with surgical drainage.

Symptoms.—Chill, fever to 104°, RCV pain, tenderness, spasm. *Duration.*—Pain and tenderness sixteen days; fever, twenty-one days.

Laboratory findings.—Blood cultures + staphylococcus aureus on tenth day. Urine culture, negative on third day. White blood cells 11,000. Urine, previous to present illness, negative. First day of renal infection, 100 white blood cells, cocci. Third day of renal infection, 200 white blood cells, cocci and colon bacilli. Tenth day of renal infection, 200 white blood cells, colon bacilli. Twenty-fifth day of renal infection, 100 white blood cells B. coli. Thirtieth day of renal infection, 50 white blood cells B. coli.

CASE IV.—Male, aged ten years. *Etiology.*—Plastic on hand with wound infection one week.

Symptoms.—Abrupt onset, chill, temperature to 103°, RCV pain, tenderness and spasm, no urinary symptoms. *Duration.*—Pain and tenderness, seven days, fever, ten days.

Laboratory findings.—White blood cells 15,000; urine: cocci, few white blood cells; urine negative on fifteenth day.

Result.—Excellent.

CASE V.—224874, male, aged eighteen years. *Etiology.*—Acute non-specific epididymitis (coccus) following upper respiratory infection, preceded his kidney infection five days.

Symptoms.—Abrupt onset, LCV pain, chill with fever to 101°, LCV tenderness and muscle spasm, frequency and burning on urination.

Duration of symptoms.—Pain, seven days; fever, three days; urinary symptoms, five days.

Laboratory findings.—White blood cells 15,000; urine: no white blood cells, loaded with cocci; normal in fifteen days.

Result.—Complete disappearance of all symptoms and signs in fifteen days.

CASE VI.—237216, male, aged eighteen years. *Etiology.*—Boil on neck with coincident head cold, five days before present illness.

Symptoms.—Severe pain localized to right kidney; nausea; chills and fever. Persisting symptoms on rest in bed for fourteen days. Temperature septic type to 103° almost daily; never any urinary symptoms. Sixteenth day increase in all symptoms. Diagnosis of perinephritic abscess. Incision and drainage. Rapid and complete recovery.

Laboratory findings.—White blood cells 25,000; urine, repeated negative examinations until tenth day when several clumps of cocci were found; four cultures negative. Culture of pus negative.

Result of treatment.—Complete recovery.

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CASE VII.—KB, 235640, male, aged twenty-seven years. *Etiology*.—Repeated catheterizations following herniorrhaphy.

Symptoms.—Chill, fever of 104° , followed in a few hours by acute severe pain in right kidney region. Examination showed extreme tenderness at this point; RCV muscle spasm.

Laboratory findings.—White blood cells 24,000; urine, occasional pus cell, no red blood cells, many cocci.

Result.—Afebrile, asymptomatic in five days; urine entirely negative in ten days.

CASE VIII.—154410, female, aged twenty years. *Etiology*.—Removal of impacted molar twenty-four hours before present illness.

Symptoms.—Onset abrupt, LCV pain, tenderness and muscle spasm, temperature to 101° , slight burning and frequency at onset lasting ten days. Duration of symptoms ten days. Afebrile in five days.

Laboratory findings.—Urine, loaded with cocci, which diminished. On twelfth day urine showed few white blood cells, no cocci, many bacilli, which disappeared in ten more days.

Result.—Complete disappearance of all symptoms and signs within three weeks.

CASE IX.—152766, male, aged thirty years. *Etiology*.—Extraction of abscessed tooth twenty-four hours before present illness.

Symptoms.—Onset abrupt, acute LCV pain, tenderness, muscle spasm, temperature not known, had gross hæmaturia at onset, frequency and burning. Symptoms and signs completely disappeared in ten days.

Laboratory findings.—Urine, many white blood corpuscles, loaded with cocci (first seen five days after onset).

Result.—Complete disappearance of all symptoms and signs.

CASE X.—124646, female, aged twenty years. *Etiology*.—Acute tonsillitis.

Symptoms.—Abrupt onset RCV pain, tenderness, muscle spasm, no urinary symptoms, temperature to 101° . Duration of symptoms six days; of fever, three days.

Laboratory findings.—White blood cells 21,000; urine, a few cocci on first day. Remained in urine twenty-two days.

Result.—Complete disappearance of all symptoms and signs in twenty-two days.

CASE XI.—127988, male, aged thirty-six years. *Etiology*.—*Cystoscopy*: for diagnosis of small right ureteral calculus; no infection in urine when first seen.

Symptoms.—Twelve hours following cystoscopy had chill, RCV pain, tenderness, muscle spasm, temperature 102° . Symptoms and signs increased for forty-eight hours and diagnosis of perinephritic abscess was made. *Operation*.—Three small cortical abscesses found in right kidney. Drained. Culture of pus, cocci. Uneventful recovery.

Laboratory findings.—White blood cells 11,000; urine: repeatedly negative; blood culture (twenty-four hours after chill) negative. Urine remained negative throughout.

Result.—Complete cure.

CASE XII.—132505, male, aged twenty-eight years. *Etiology*.—Upper respiratory infection.

Symptoms.—Abrupt onset, LCV pain, tenderness, muscle spasm, gross hæmaturia at onset lasting ten days, temperature 100° . Duration of pain, twenty-four hours; temperature three days.

Laboratory findings.—White blood cells 11,000; urine, gross blood, no pus, many cocci. Cocci in urine nineteen days, blood in urine ten days.

Result.—Complete cure.

CASE XIII.—134388, male, aged twenty-two years. *Etiology*.—Upper respiratory infection.

Symptoms.—Onset abrupt, RCV pain, tenderness and spasm. Some frequency and burning. Symptoms all subsided in eight days.

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Laboratory findings.—Urine negative at twenty-four hours; fourth day 200 white blood cells/per low-power field, loaded with cocci; culture of urine positive for cocci; urine negative at fifteen days.

Result.—Complete recovery fifteen days.

CASE XIV.—211490, male, aged fifty-six years. *Etiology.*—Upper respiratory infection.

Symptoms.—Onset abrupt, chill with fever to 101° , LCV pain, tenderness and spasm, slight frequency. Duration of pain and tenderness three days; fever two days; frequency one day.

Laboratory findings.—Urine few cocci, which cleared up in five days.

Result.—Complete cure.

CASE XV.—220874, male, aged eighteen years. *Etiology.*—Upper respiratory infection.

Symptoms.—Onset abrupt, pain, tenderness, spasm, region of left kidney, nausea, no vomiting. Chills with fever to 104° , frequency, no burning. Tenth day (on admission) terrific left renal colic eight hours' duration. X-rays no stone. Left kidney enlarged, tender.

Laboratory findings.—White blood cells 20,000, urine 10-15 white blood cells/per low-power field, many cocci.

Cystoscopy.—? left hydronephrosis. Bladder negative, no obstruction or renal pelvis/residual found. Specimens: right negative; left, loaded with cocci. No pus.

Progress.—Fifteenth day symptoms and signs began to improve. Eighteenth day symptoms gone, kidney only slightly tender, no fever. Urine, few cocci and bacilli; no pus.

CASE XVI.—208504, female, aged twenty-six years. *Etiology.*—Acute tonsillitis.

Symptoms.—Abrupt onset, LCV pain, tenderness and spasm, 103° , frequency and urgency. *Duration.*—Pain, ten days; fever, 3 days; urinary symptoms, five days.

Laboratory findings.—White blood cells, 14,000; urine, negative at onset; few cocci third day; many cocci sixth day; twelfth day negative.

Result.—Cured.

CASE XVII.—202735, male, aged thirty years. *Etiology.*—Upper respiratory infection.

Symptoms.—Abrupt onset, RCV pain, bilateral CV tenderness and spasm, frequency, temperature and leucocytosis not known. Duration of pain, two weeks; urinary symptoms five weeks.

Laboratory findings.—Urine, no white blood cells, loaded with cocci. Urine gradually cleared, being normal in two months.

Result.—Cure.

CASE XVIII.—229553, male, aged eighteen years. *Etiology.*—Catheterization, post-operative.

Symptoms.—Chill, fever to 104° , RCV pain, tenderness, spasm. *Duration.*—Pain and tenderness, ten days; fever, ten days.

Laboratory findings.—White blood cells, 12,500; urine at onset, many cocci, no white blood cells; three days later, many cocci, 100 wbc/per low-power field; at fourteen days, cocci, bacilli, 200 wbc/per low-power field; at twenty-one days, rare cocci, many bacilli, 100 white blood cells; at forty days, few bacilli, occasional white blood cells.

Result.—Excellent.

CASE XIX.—219788, female, aged forty-four years. *Etiology.*—Cholecystectomy for cholecystitis and cholelithiasis four days before present illness. (Poor operative risk)

Symptoms.—Chill, fever to 103° at onset, general weakness, nausea and vomiting, abdominal distention, severe LCV, tenderness and spasm. All symptoms and signs increased progressively for fourteen days, signs shifting from one kidney region to the other. Patient in extremis for twenty-one days. Began gradually to improve at twenty-fifth day then on thirtieth day became much worse. Obviously bilateral condition per-

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sisting. Septic temperature continues. At fifty-fifth day began to improve slightly having no chills from that day on. Gradual steady improvement; on seventy-fifth day discharged. Recent letter from patient (three months after discharge) states she is quite well.

Laboratory findings.—Repeated negative urines, pre-operative; at onset of renal infection—many cocci, no white blood cells; seventh day of renal infection—white blood cells, 200, cocci, bacilli; twenty-fifth day of renal infection—white blood cells, 200, occasional cocci, many bacilli.

ETIOLOGY UNKNOWN

CASE XX.—225397, male, aged forty-three years. *Symptoms.*—Onset abrupt, severe RLQ pain with nausea, no vomiting. Twenty-four hours later RUQ and RCV pain with soreness in right testis. Slight urgency of urination. Fever to 102°. Chill with temperature to 104° on third day. Abdomen soft throughout. RCV tenderness and spasm. Tender along ureter.

Laboratory findings.—White blood cells 14,000; urine, no white blood cells, loaded with cocci.

Result.—Improved rapidly after fifth day. Fever gone on seventh. All symptoms gone on ninth day. Urine on eleventh day showed but few cocci.

CASE XXI.—216926, female, aged twenty-five years. *Symptoms.*—Abrupt onset, RCV pain, tenderness and muscle spasm. Frequency and burning. Temperature 99.6°. Duration of pain two weeks, fever two weeks, bladder symptoms one month.

Laboratory findings.—Urine (one week after onset) many white blood cells, loaded with cocci; one month later, no white blood cells, a few cocci.

Result.—Excellent.

CASE XXII.—199016, male, aged fourteen years. *Symptoms.*—Onset abrupt, entered hospital with diagnosis of typhoid on account of septic temperature and tumor in left flank thought to be spleen. *Examination.*—Extreme emaciation, severe LUQ pain, tenderness and spasm. X-rays negative for empyema so chest tapped, negative findings. Tumor in LUQ and flank was exquisitely tender. This proved to be left kidney.

Laboratory findings.—White blood cells 14,000; urine, many cocci, few white blood cells. Blood culture + cocci on one occasion following chill.

Progress and result.—Duration of pain, five weeks; of fever, four weeks.

Result.—Six weeks after admission was apparently entirely well.

CASE XXIII.—138227, male, aged twenty-one years. *Symptoms.*—RCV and RUQ, pain, abrupt in onset. RCV tenderness and spasm. Hematuria at onset lasting three days. Temperature 99.8° on third day. Duration of pain, six days; fever, two days.

Laboratory findings.—Gross hæmaturia; cocci which appeared in urine on fourth day. Culture: cocci. Urine negative after fourteen days. Cystoscopy.—Negative. Right specimen + cocci microscopic and culture. Left specimen — cocci microscopic and culture.

Results.—Complete recovery.

CASE XXIV.—139752, male, aged thirty-eight years. *Symptoms.*—Abrupt onset, chills with fever, left CV pain and tenderness with spasm. Frequency and burning. *Cystoscopy.*—Bladder showed spotted inflammation. Duration of pain twelve days. Frequency and burning eighteen days.

Laboratory findings.—Urine (fourth day), many white blood cells and cocci in both ureter specimens + cocci by culture and stain. Pus persisted in urine three months, cocci five months.

Results.—Complete recovery.

CASE XXV.—155404, male, aged fifty-six years. *Symptoms.*—Abrupt onset, chills with 103° fever, right renal colic and constant pain, tenderness, muscle spasm. No

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symptoms on left. *Cystoscopy*.—Negative. Both ureter specimens + cocci by culture and by stain.

Laboratory findings.—White blood cells 24,000, urine, 200 white blood cells, loaded with cocci. Failed to improve eleven days. Operated, right kidney found to be large, purple, contained many pin-head-sized abscesses. Nothing done at operation. Patient died post-operative two days. No autopsy.

CASE XXVI.—157413, male, aged twenty-one years. *Symptoms*.—Abrupt RCV pain, tenderness and spasm, chills and fever to 105°, slight frequency and burning. Remained constant fourteen days then increased local signs. Diagnosis then made of perinephritic abscess and patient operated. Right kidney showed three moderate-sized cortical abscesses and perinephritic abscess localized medially. Culture of pus showed cocci.

Laboratory findings.—White blood cells 18,000; urine, few white blood cells, loaded with cocci; culture negative. *Cystoscopy*.—Before operation, bladder negative, right specimen cocci; left negative.

Result.—Complete cure by drainage of abscess. Urine became free of cocci in six months.

CASE XXVII.—218089, male, aged forty-nine years. *Symptoms*.—Bilateral CV pain, tenderness, frequency and burning, occasional chills and fever. Was up and about the entire period of his illness. Duration of pain, six months; frequency and burning, six months; chills and fever, off and on three weeks.

Laboratory findings.—Urine loaded with cocci; no pus. Refused treatment.

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VESICOVAGINAL FISTULA

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IT APPEARS to be the opinion of some writers in these days of improved obstetrical methods that vesicovaginal fistulae are becoming increasingly rare. Either that this is not the case, or that more attention is being directed to this unfortunate lesion, is indicated by the fact that the medical indices in 1916 showed only two articles under this caption, while in 1929 twenty-nine articles appeared.

The casualties of childbirth are still with us, but obstetrical accident is not the only cause of a vesicovaginal fistula; it may result from a surgical accident in the course of a pelvic operation; it may be due to malignancies of the bladder or cervix; or it may result from the application of radium in the treatment of a pelvic malignancy—to cite the most frequent causes.

It is perhaps not generally known, or has been forgotten by many, that the Woman's Hospital of New York was founded by Marion Sims solely for the treatment of vesicovaginal fistula, and that at that time, the incidence of the condition was so high that during the period from 1856 to 1861, he performed on an average of two operations a week for urethrovaginal and vesicovaginal fistula, and in a report in 1867 he analyzed 275 cases of injury of the vesicovaginal septum!

Sims was by no means the first to recognize the seriousness of this condition or to attempt to cure it. Even Hippocrates refers to it. Paré recommended a method of treatment. In 1660 van Roonhyzen attempted unsuccessfully to close a vesicovaginal fistula by suture, and from 1800 on, various procedures were recommended, some of which, in isolated cases, proved successful. But to J. Marion Sims, more than to any other surgeon, is due the credit for the development of a method for the exposure of the fistula and of a technic for closing it.

It is not necessary to describe Sims's operation nor the various methods and devices which have been proposed since his time by Kelly,² Frank,³ C. H. Mayo,⁴ Chute,⁵ Roeder,⁶ Young,⁷ Legueu,⁸ George Gray Ward,⁹ and others. The important point is that the very variety of these methods emphasizes the fact that no one method is always reliable. This is emphasized also by the facts that in most of the cases that I have seen repeated attempts at correction have been unsuccessful, and further treatment has been made difficult by the presence around the opening of very hard, fixed scar tissue. It follows, then, that the treatment of a vesicovaginal fistula must be strictly individualized, the choice of method depending upon the position of the opening, its size, and the amount of cicatricial tissue that surrounds it.

One thing is certain—the surgeon should be prepared to bring to the aid

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of the unfortunate women who are affected with this deplorable condition every resource at his command. The situation is rendered all the more tragic by the fact that the condition is rarely due to any fault on the part of the woman in whom it is present, but rather to circumstances of childbirth or of operation over which she has no control.

Etiology.—As stated above, a vesicovaginal fistula may be due to direct surgical injury, to an interference with the blood-supply of this area in the vagina and bladder by suture or by pressure of the fetal head, or to injury by forceps in the course of a delivery. According to Kelly,² the last-mentioned cause is rare, the danger being not from the use of forceps, but rather from too great delay in using them. A pessary may cause a fistula. W. L. Finton¹⁰ has reported an interesting case of this type in which a retained contraceptive device called a "bee-cell" caused tension of the vaginal septum with resultant vesicovaginal and rectovaginal fistulae, each two centi-

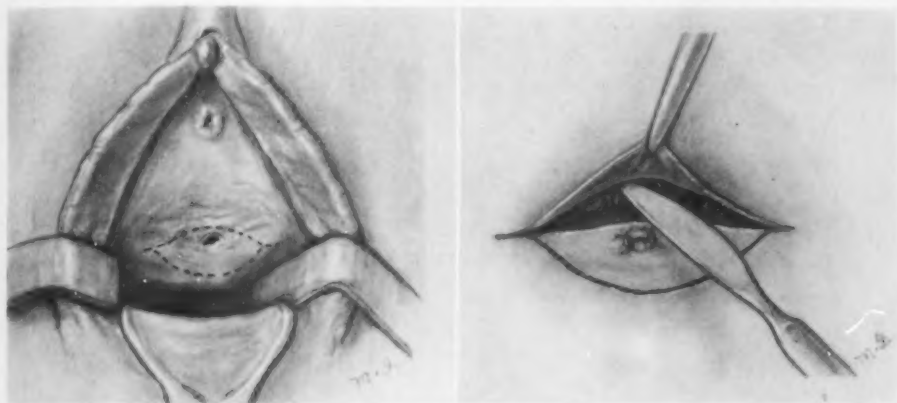


FIG. 1.—Operation for vesicovaginal fistula, Step I. FIG. 2.—Operation for vesicovaginal fistula, Step II.

metres in diameter. Syphilis or cancer may destroy the vaginal wall, and Kelly adds the possibility of sloughing from a hematoma of the septum.

Incidence.—I can find no direct references to the incidence of vesicovaginal fistulae except that they are rare. I have already referred to the 275 cases reported by Sims in 1867. Bissell¹ reports that during the ten years previous to 1929, only fifty-eight patients were operated upon in the Woman's Hospital of New York for the repair of vesicovaginal or urethrovaginal injuries. This variation in numbers, however, cannot be taken as a true index to a lessened incidence, for in Sims's day few surgeons besides himself had directed their attention to the repair of vesicovaginal fistula, while today many surgeons understand the necessary repair. In my own practice I have had under observation thirty-two cases of vesicovaginal fistula, and have operated upon twenty-seven patients.

Diagnosis.—The diagnosis of vesicovaginal fistula presents but little difficulty. The principal symptom is incontinence of urine accompanied by excoriations of the vaginal mucosa. It should be borne in mind, however,

that in the case of a small fistula situated high in the vagina, most of the urine may be voided normally. In any case of incontinence of urine, especially if the patient has had deliveries or has been subjected to a pelvic operation, the vagina should be carefully examined to determine whether or not a fistula is present. In case of doubt, dye may be injected into the bladder, its appearance on the vagina indicating both the presence of a fistula and its site.

It is of special importance to determine whether or not more than one fistula is present, whether the cervix or the neck of the bladder is included

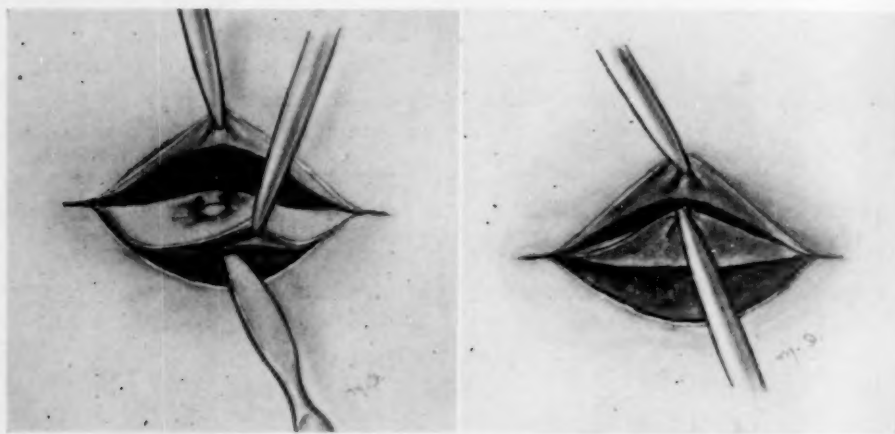


FIG. 3.—Operation for vesicovaginal fistula, Step III. FIG. 4.—Operation for vesicovaginal fistula, Step IV.

in the fistula, and whether or not a rectovaginal fistula also exists, as these findings have an important bearing upon the type of operation to be performed.

Treatment.—As before mentioned, the treatment for vesicovaginal fistula must be individualized, for while certain forms of technic which have been described by various authors have proved successful in some cases, they will not be successful in all cases. My own preference is operation by the vaginal route. A good exposure of the opening is essential. The parts should be thoroughly relaxed, and this is best accomplished by spinal anaesthesia. Early surgical intervention in cases of vesicovaginal fistula is important if primary healing is to be secured, unless the fistula is small, in which case it is safe to wait to see if it will heal without a plastic operation—simply by the use of an inlying catheter. To wait until much scar tissue has formed, or until there are considerable deposits of urinary sediment is to invite greater difficulty. If the first attempt to close the fistula fails, a second attempt should not be undertaken while the tissues are devitalized. A technic which has proved successful in the greater number of my own cases is here illustrated (Figs. 1 to 6).

Occasionally the opening is too great, or the tissues are so fixed that there is no hope of success from a local plastic operation. In such cases a ureteral

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transplantation should be done. I performed a ureteral transplantation in one case in which at the first delivery the whole base of the bladder sloughed, and repeated local efforts to close the bladder failed. The ureters were transplanted into the rectum. The patient afterwards became pregnant and a living, normal child was delivered by Cæsarean section. This was seven years ago, and the mother and child are living and well.

I have performed forty-four operations on twenty-seven patients with vesicovaginal fistula. In fifteen of these cases repeated operations were performed before the fistula was finally closed.

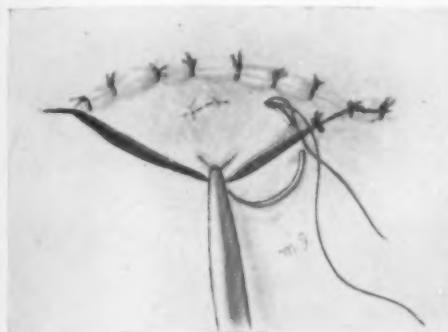


FIG. 5.—Operation for vesicovaginal fistula, Step V.



FIG. 6.—Operation for vesicovaginal fistula, Step VI.

Among the patients regarding whom we have been able to get follow-up reports, the results of operation have been completely satisfactory in 90 per cent. of the cases.

CONCLUSIONS

(1) Vesicovaginal fistula is probably the most distressing non-fatal condition that can occur in a woman.

(2) In severe pelvic operations, isolation of the ureters is important, and if the bladder or a ureter is injured, it should be taken care of at once.

(3) In the majority of our cases, operation by the vaginal route has proved to be the best method.

(4) No one type of operation suits all cases. Each case must be considered individually. By persistent efforts, most cases can be cured by plastic operation.

(5) If plastic operation fails, a ureteral transplantation should be done.

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PROGRESSIVE, GANGRENOUS, PAINFUL ULCERATION OF THE ABDOMINAL SKIN AND SUBCUTANEOUS TISSUES FOLLOWING OPERATION

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OPERATIVE wounds, even if infected, usually heal satisfactorily, but occasionally, especially about the abdomen, a stubborn, painful, ulcerating, gangrenous process attacks the surrounding skin, without involving underlying structures, and progresses indefinitely, resisting all ordinary treatment, until it is checked by more or less heroic surgical measures. This serious affection fortunately is rare, although perhaps more common than the literature would indicate. It is not mentioned in most text-books, and I have been able to find only five articles on the subject, describing but five cases. [See "Literature" at end of article.] All of these occurred in connection with suppurating wounds, mostly in operations for appendicitis, and in none of them was any general disease demonstrated, or any specific process, such as syphilis, tuberculosis, blastomycosis, *etc.*, which could with certainty be regarded as the cause.

The trouble begins a number of days after an operation, often a week to two weeks, and then not in the entire wound at once, but in some isolated portion, nearly always around a stitch-hole. A dusky redness of the skin at first appears, followed more or less rapidly by brawny induration, resembling a carbuncle, the color soon changing from red to livid and then black, as gangrene develops in the centre. In the meantime the red border of the lesion spreads slowly and irregularly, sometimes far in advance of the increasing induration and without relation to the distribution of nerves or blood-vessels. In the end, the affected area is not unlike a bad X-ray burn in appearance. (Fig. 1.)

The progress is not constant, showing exacerbations and remissions without apparent cause, and exhibiting renewed activity after temporary cessation. Large and small blisters frequently appear.

A characteristic feature is the severe, almost unendurable pain, which is mentioned by all writers. This appears early and is accompanied by exquisite tenderness; and although it may subside during a remission, it reappears with each exacerbation. It is so intense that individuals have been known to threaten suicide, and Christopher's² patient had to be anæsthetized when dressings were done. In my own case it was by far the most prominent symptom, reminding one of the pain of herpes zoster. Under its influence, aided by absence of sleep and appetite, patients lose flesh and strength rapidly and their morale is soon destroyed.

The course of the trouble is exasperatingly slow, lasting for weeks or

months unless checked by surgical means. There seems to be no limit to its progress. In Christopher's case the whole of the left side of the back, the flank and a portion of the anterior abdominal wall finally became involved, and it has been known to extend from the abdomen to the thigh.

A moderate rise in temperature, seldom over 102° , accompanies the early stages; but this soon disappears, or is reduced to a slight elevation, although it has a tendency to reappear at each exacerbation.

Suppuration is not an essential feature, although it usually is co-existent. It does not occur within the reddened or indurated tissues, and does not necessarily precede the disease. In my own case the wound had healed by primary union, the infecting agent apparently gaining access on the eleventh day through a stitch-hole, thus making it probable that in some instances, at least, infection takes place from without, rather than from the intestinal tract, as has been supposed.

The cause of this baffling lesion is unknown, unless we accept Brewer's theory, concurred in by Mayeda⁵ and Shipley,⁴ that it is due to a symbiosis of micro-organisms. Brewer and Meleny³ succeeded in isolating two kinds of bacteria—a non-hemolytic streptococcus and a hemolytic staphylococcus. When one of these alone was injected into the skin of an animal, nothing of importance resulted, but when a mixture of the two was employed a gangrenous ulceration was produced. Although Brewer's experiments are interesting and suggestive, I am not aware that they have been substantiated by others. Although various organisms repeatedly have been found, none of them has been established definitely as a cause.

The extreme pain accompanying all cases would suggest a lesion of the nerves or their spinal ganglia, similar to that occurring in herpes zoster, if it were not for the fact that the local inflammation seems to precede the pain, although this would not preclude a nerve involvement secondarily. We are perhaps justified in assuming that a lowered resistance of the tissues may play a part, as in noma, perhaps due to trophic disturbances or to some other more or less general factor.

In this extraordinarily stubborn disease all ordinary methods of treatment, including multiple incisions (Brewer), have been useless. Mayeda,⁵ for instance, systematically tried many things without success. He lists them as follows:

1. Powders—iodoform, dermatol, yatren, *etc.*
2. Salves—boric acid, pythylol, orthoform, zinc oxide, belladonna, *etc.*
3. Fomentations—boric acid, sodium chloride, rivanol, bichloride of mercury, potassium permanganate, pyrozone, *etc.*
4. Baths—potassium permanganate, lysol, sodium chloride, *etc.*
5. Continuous irrigation—rivanol, pyrozone, sodium chloride, *etc.*
6. Injections into surrounding infected tissues—rivanol, carbolic acid, oxygen, *etc.*
7. Local steam-douches.
8. Local use of X-ray, artificial sunlight.

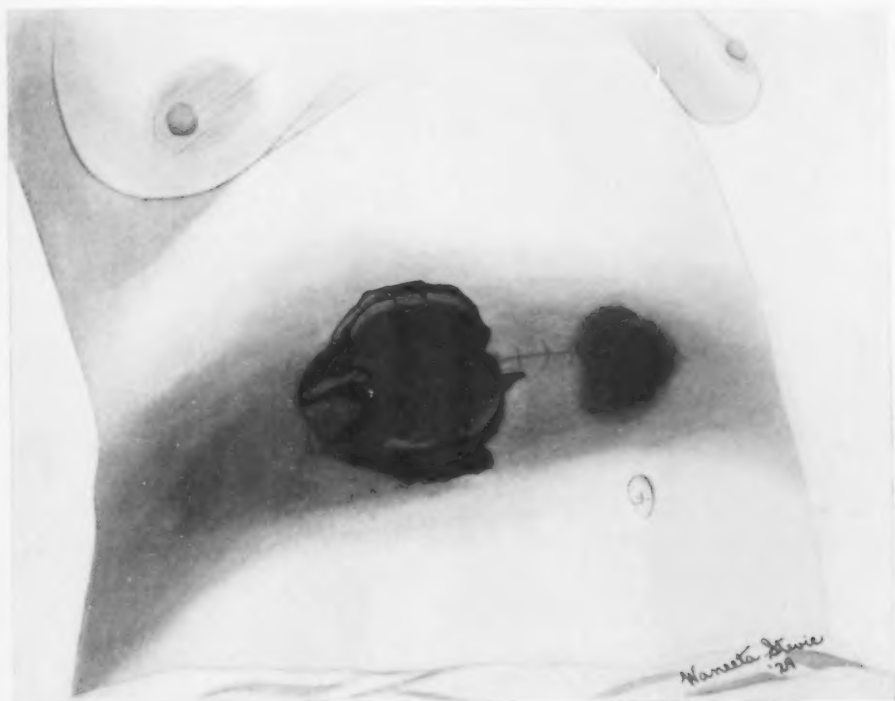
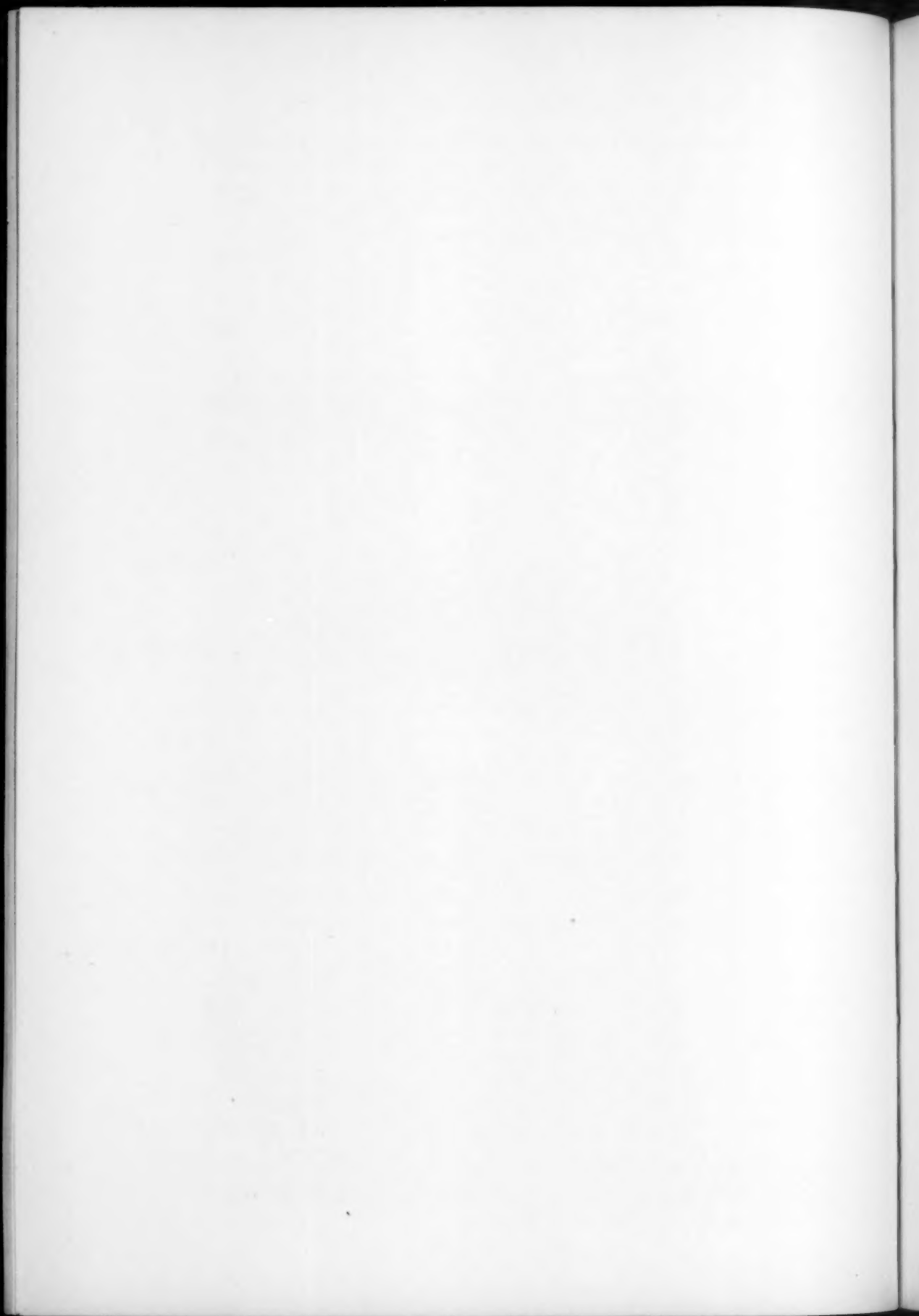


FIG. 1.—Water color drawing made about 16 hours post mortem (author's case).



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9. Intravenous injections—calcium chloride, salvarsan, glucose, sodium chloride, *etc.*
10. Vaccines—colon Bacillus, staphylococci, streptococci.
11. X-ray applied to spleen.
12. Injections of proteins—patient's own blood and serum, horse-serum, human serum, *etc.*
13. Internally—yatren, potassium iodide, *etc.*

The only way to check the relentless spread of the trouble seems to be the use of the actual cautery, and nearly all those who have reported cases have had to resort to this in the end. In order to accomplish anything it is necessary to go well beyond the red margin, into sound skin, burning a gutter down through the subcutaneous tissues. In addition, the entire diseased area may be cauterized, although Brewer obtained satisfactory results by packing the gutter with gauze saturated with 1 per cent. formalin. Excision with the scalpel is perhaps inadvisable on account of hæmorrhage and the danger of re-infection. The results of such operations have been immediate and gratifying, although earlier diagnosis and cauterization undoubtedly would improve them. Skin grafting may be done later on, but healing may take place spontaneously, especially when islands of undestroyed skin remain.

CASE HISTORY.—A well-developed and well-nourished woman, thirty-nine years of age, with a tuberculous family history. Two operations had been performed a number of years previously; one upon the uterus and tubes, which was followed by pneumonia and erysipelas; and another an induced abortion, followed by an almost fatal acute nephritis.

For a year or more she had suffered much with the ordinary symptoms of chronic cholecystitis, gall-stones being revealed by the X-ray. The urine was negative, erythrocytes 4,420,000 and hæmoglobin 81 per cent.

March 27, 1929, through a transverse incision, a cholecystectomy was done and an obliterating appendix removed. The wound was closed without drainage. The superficial stitches were removed on the ninth day. There was satisfactory healing of the wound with no signs of inflammation. Several deep "button-sutures" were permitted to remain in place, there being no cutaneous reaction.

On the eleventh day the patient was permitted to get out of bed, her temperature being normal and her condition satisfactory; but in the afternoon the temperature rose to 101°, accompanied by headache and general malaise. Nothing abnormal was then observed in connection with the incision.

On the twelfth day a severe burning pain developed in the wound, extending around the flank towards the spine, and on removal of the deep sutures one of the stitch-holes exhibited redness and irritation and seemed to be the centre of the discomfort. From this time on the skin surrounding the wound, to a distance of about two fingers' breadth on either side, rapidly became swollen, indurated, dull red in color and exquisitely tender, like a great carbuncle, while the burning pain increased in intensity until it was almost unbearable. During the next two weeks the inflamed area slowly turned livid in color; and at the end of about three weeks was black and frankly gangrenous, the slough being dry and leathery. The whole area somewhat resembled a severe X-ray burn. At no time was there an abscess present or other evidence of either deep or superficial suppuration. The process did not extend to the underlying parts, but confined itself to the skin and subcutaneous tissues.

The treatment, outside of general measures, consisted at first in the application of

warm boric-acid fomentations. Later various ointments and solutions were employed, but without effect.

As soon as the gangrene was complete and the sloughs cut away with scissors the pain largely disappeared, although the patient was left exhausted and anæmic. The highest temperature (102°) was on the sixteenth day. After this it slowly declined to 99° and 100° , where it remained.

Following the development of gangrene there appeared to be a short remission of the process; but soon it began to extend again, the skin slowly becoming red far beyond the original incision clear around to the spine on the right and several inches past the median line on the left, there being little extension longitudinally. The redness far outstripped the induration, which usually, but not always, followed later. The progression was at no time serpiginous, as has been noted in other cases.

About four weeks after the onset of the trouble, although the urine previously had been negative, a nephritis developed, accompanied by œdema, particularly of the right arm, face and neck, and on May fifteenth death took place from uræmia, the disease having ceased to advance shortly before that time. The intention was to have excised the entire lesion with the actual cautery, but this was prevented by the critical condition engendered by the nephritis.

After death the red area of skin retained its color unchanged, as shown by the accompanying drawing, which was made about sixteen hours post-mortem (Fig. 1), thus indicating, perhaps, the hæmolytic action of the microbic cause, which, however, could not be determined from among a confusing multitude of micro-organisms.

Dr. C. E. Tennant, of Denver, kindly permits me to mention an unpublished case of his. The trouble followed an operation for ventral hernia done in 1925 on a woman of sixty-four. It appeared in a stitch-hole on about the eighth day, manifesting itself by marked redness and induration, but no suppuration, the wound having healed primarily. The progress was rapid, the skin quickly becoming livid and then gangrenous, intense pain being always a predominant feature. The lesion, which was in the right hypochondriac region, finally attained a size of about six by nine inches, reaching well across the median line and involving the skin and subcutaneous tissues, but not the muscles. The highest temperature, 102° , was reached within a week, but it soon dropped to about 100° , where it remained indefinitely. A Wassermann test was negative, as were also the urinary findings.

In the treatment, all sorts of antiseptics were tried without effect, but by the industrious use of artificial and direct sunlight the disease finally was arrested at the end of four months. After several ineffective attempts at skin grafting, cicatrization took place spontaneously, but the woman never recovered her terribly shaken morale and committed suicide within a year. The original operation was a cholecystectomy, and Doctor Tennant has always been inclined to connect the progressive gangrene with hepatic insufficiency.

Cole and Heideman⁶ report a typical case in which the trouble started in a stitch-hole of a stay-suture seventeen days following a drainage operation for appendicitis. There was the usual intense pain, tenderness, brawny redness, gangrene, stubborn persistence and extension of the process, in spite of all treatment, until it was finally checked in about five months by the use of the actual cautery, after it had involved a large portion of the skin of the abdomen.

In spite of the fact that there was no history of dysentery, and emœbas could not be found in the appendix, the authors felt that the trouble was amœbic in origin, because they found the organism in the pus and tissues, and the progress of the disease seemed to be slowed by the injection of emetin. Further observation is necessary, however, before accepting this conclusion.

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SUMMARY

A rare wound-infection is described, occurring principally, but not always, in connection with abdominal incisions.

It begins usually in a stitch-hole a number of days following an operation and spreads slowly and indefinitely, causing marked induration of the skin, which is at first red, then livid and finally gangrenous. The process is accompanied by intense pain and tenderness and moderate fever, and may last for weeks or months, causing great physical and nervous exhaustion and possibly resulting in death.

The cause is obscure, although an amœba has been suggested by Cole and Heideman, and the symbiotic action of a streptococcus and a staphylococcus by Brewer and Meleny.

It usually has been found in connection with suppurating wounds, but in the writer's case it began in a stitch-hole, following primary union of a gall-bladder incision without drainage.

All ordinary methods of treatment usually have failed, the only effective remedy being the heroic use of the actual cautery.

LITERATURE

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DISCUSSION: DR. J. SHELTON HORSLEY, of Richmond, Va.: I have had one case, not exactly similar to Doctor Freeman's, but it apparently came from the same cause. It followed an operation for intestinal obstruction on a man about sixty-five years of age. It was due to an intussusception from a lipoma in the submucosa of the ileum. After removing the cause of the obstruction, the bowel was very much dilated and I did an oblique tube enterostomy. There was so much distention that the original McBurney incision was supplemented by a rectus incision, running up the right rectus muscle and so turning up a triangular flap. The patient made an immediate satisfactory recovery. There was some infection of the wound, then gangrene started in the angle of the incision. This spread in the direction of the right side, following in a general way the nerves and vessels and involving the adjoining tissues. It was not particularly painful. Finally, after about a week or ten days there developed a gangrenous mass including not only the skin but the whole thickness of the abdominal wall from near the mid-line up

to the lumbar region. It was obvious that the intestines would break through, for they were held back by very flimsy necrotic tissues, so I excised the whole gangrenous area with an electric cautery, leaving a large amount of intestines with very few adhesions exposed. Temporarily, to stop the defect, I put in a piece of rubber inner tube from an automobile tire, knowing that rubber is not very irritating to tissues, and sutured it with mattress sutures, and left that for a week. In the meantime the section of rubber had stimulated adhesions and exudate and after about a week it was removed. Then a flap was outlined from the skin above and in stages transplanted over the defect, leaving, of course, only the skin and subcutaneous fat and fascia. After a series of operations the wound healed satisfactorily. He wears a support and gets along fairly well with it. Of course he has no actual musculature support. The interesting thing is that all of the abdominal wall was involved in the gangrenous process from the skin down to and including the peritoneum. It was not painful and it was promptly checked by a rather thorough eradication with the electric cautery. This case is reported in full in the *Archives of Surgery* for March, 1929, vol. xviii, pp. 882-891.

DR. EMORY G. ALEXANDER, of Philadelphia, recalled a case which he reported several years ago before a joint meeting of the New York Surgical Society and the Philadelphia Academy of Surgery. Doctor Brewer incorporated this case in his report of a similar condition which he reported before this association. The condition followed an operation for an appendiceal abscess and was quite typical of what Doctor Freeman has described. Two or three weeks following the operation the trouble began around an infected silkworm-gut stitch; the infection traveled outward to the crest of the ilium, thence downward over anterior and lateral aspects of the thigh to the knee; this infection seemed to travel in waves of about three weeks' periodicity. Dr. Jay Schamberg, of this city, saw this patient in consultation and he termed it a gangrenous dermatitis and stated that he had seen similar conditions in smallpox. Doctor Brewer was working on an anaërobic organism that he thought probably might be the causative factor. In this case we tried every sort of antiseptic. None seemed to be of any avail. Very little benefit was derived from heliotherapy. The condition finally burned itself out and the patient recovered.

DR. MAX BALLIN, of Detroit, Michigan, said that within the last year he had seen four such cases of post-operative gangrene.

As to the location of the gangrene, this can happen almost anywhere in the body where a draining wound exists.

The first one of his four cases concerned a boy eight years of age. The gangrene developed about the incision for drainage of an inguinal gland abscess. The process in this case lasted twenty-two months until healing was established.

The second case was very similar to Doctor Freeman's; it followed the drainage of a case of gangrenous appendicitis, and recovered within thirty days after onset.

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The third case followed in a fistula from a thoracotomy for empyema. The picture of this gangrene was very much like the picture in the case published by Christopher, of Chicago. The gangrene lasted ten months before it healed.

The fourth case developed in a fistulous tract resulting from an abscess of the epididymis breaking through the scrotum. Also here, the typical undermining of the skin and the serpiginous cutaneous edges were present as in all other cases. In contrast with this rather dry and slow form of gangrene is the moist, rapid, very fatal gangrene of the scrotum originating from intestinal anaerobes coming from a pararectal abscess or breaking through of a suppurative diverticulitis of the sigmoid into the scrotum.

As to the treatment of the gangrene under discussion, Shipley's proposal to recognize these cases early and then to remove the whole gangrenous area by excising it with the electro-cautery knife, is the proper method. This can be followed in a very few days, less than a week, by skin grafting. In this way he succeeded in bringing the post-appendiceal case to a cure in thirty days; the scrotal gangrene healed in two weeks following the cautery treatment, after the process had existed from three to four months previously.

All serum and different light and antiseptic treatments are usually of no avail and merely allow the progress of the affection.

STUDY IN POST-OPERATIVE BLOOD CHEMISTRY

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FOLLOWING an ether anæsthesia and a surgical operation the patient generally lies for twenty-four to forty-eight hours in an exceedingly depressed condition which is very difficult to describe accurately. Nevertheless, it is a rather clear-cut clinical syndrome. I am not speaking here of those cases of frank shock or collapse due to extensive traumatism, infection or hæmorrhage. I wish to rule out those cases of definite post-operative complications including frank infection or starvation acidosis and our studies concern simply that state in which all patients return from the operating room and remain for variable periods of time. We may well use the term "post-anæsthetic sickness" as used by Mackenzie¹ in a recent paper.

As stated above, this condition does not present any clear-cut clinical symptoms. However, our patients are all profoundly depressed, even after the effect of the anæsthetic has apparently worn off. They are very weak; the pulse is often slow; the skin is cold and pale. They are unable to retain food or water and do not respond normally to external stimuli. The condition corresponds rather closely with that of the after-results of a severe alcoholic intoxication, and of course the "hang-over" following a "spree" would naturally be expected to bear a close resemblance because of the very similar pharmacological effects of alcohol and ether. The following studies are an attempt to analyze the various factors in this condition by careful studies in blood chemistry, to evaluate their importance, and perhaps to suggest methods of therapy.

Experimental.—The experiments undertaken were studies on normal human and animal organisms of the effect of operations of moderate severity. Only individuals were chosen who were normal or practically normal to begin with; that is, at least patients who were not toxic or acutely ill at the time of operation, so that their pre-operative condition could be used as a control in the blood chemical studies. The cases studied included hernias, individuals with cholelithiasis who were operated on during afebrile periods, and in the absence of jaundice and pain, hysterectomies and appendectomies, also operated on during intervals between attacks. The two appendectomies in the charts were difficult cases complicated by adhesions in which considerable trauma was necessary to get the appendix out. These cases were kept under continual observation for twenty-four to forty-eight hours by one of us and specimens of blood were drawn at very frequent intervals, as is illustrated by the curves. No special after-treatment was instituted and in no case was any medication given which would be likely to affect the blood

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chemistry to any great extent. In fact, occasional doses of morphine were the only medication permitted. In no cases were normal salt solution or glucose given either rectally, subcutaneously or intravenously, and there was in most instances a practically complete starvation both as to food and water for twenty-four hours. At the end of twenty-four hours in those cases in which the studies were continued beyond that, practically negligible amounts of water and fruit juices were given by mouth. The details of each experiment are given in the subtitles of the charts.

Shock.—The condition of post-anæsthetic sickness is frequently described as post-operative shock, but the most cursory analysis of our charts shows clearly that shock in its modern conception is most certainly not present in these routine cases. A definition of shock today is difficult to give and it is classified under various heads. Whether we accept Crile's² conception of "a depression of the vital cerebral centres due to an excessive stimulation and resulting in a vasomotor paralysis," or the older concept of an exanguination into the portal system, one must admit that in its broader scope shock is characterized by a fall in blood-pressure. This feature was conspicuously absent from all of the cases studied by us, where careful blood-pressure estimations were made at very short intervals. Besides this absence of a fall in blood-pressure it will be perfectly obvious from an analysis of the patients operated on and the extent of surgery undertaken that, whereas a fall in blood-pressure during an operation may be more or less significantly great, a prolonged low blood-pressure during the following day is rather rare.

The next important criterion of shock is an elevation of the pulse rate, and not only our own charts here, but common clinical observation tells us that this does not take place. In fact, the opposite is more often true and the pulse in the post-anæsthetic period tends to run lower than normal. The above observations, we believe, make it impossible to set the term "post-operative shock" as having any meaning in anæsthetic sickness.

Cannon's³ theory of shock, that is, the absorption of toxic material from traumatized tissue, has received an interesting confirmation in the hands of Buerger and Grauhan.⁴ The latter authors have demonstrated a constant rise in the non-protein nitrogen in the blood during the first week following an operation. They are at a loss to explain this phenomenon occurring at a time when the intake of nitrogen is practically zero on any other basis than as the breaking up of protein material most likely from the operative field. While one might not wish to go so far as to agree with the latter authors that this is "direct proof of the presence of the product of protein disintegration in the blood-stream," the assumption is at least to be considered and we believe it is quite suggestive in view of the changes in the blood calcium and permeability to be reported later.

Acidosis.—Frequent claims have been made that acidosis is a prominent feature in post-operative toxæmias. Our studies have shown that this was a totally unwarranted assumption and in all of the cases which were studied intensively both the carbon dioxide combining power of the blood serum as

determined by the Van Slyke⁵ method and the blood chlorides⁶ determined at almost hourly intervals showed no fluctuation which was outside the limits of normal. In most cases the two ran fairly parallel to each other. This was not the invariable rule by any means, the minor fluctuations of the two curves occurring quite independently of each other. While, in general, there is a slight trend toward the acid findings in the post-operative period, it is very slight indeed, and in many cases an actual rise occurs in the carbon dioxide and a fall in chloride probably brought about by small amounts of emesis, although no cases are reported in this series where the emesis was profuse and frequent enough to bring about an alkalosis. The latter, of course, is a perfectly definite syndrome which is clearly understood and whose symptoms are quite different from the ordinary post-operative course.

It may here be noted that such a condition (acidosis) might well have been a feature a few years ago when it was the custom to starve patients before operation and even to deprive them of the normal intake of water. Such is not the case now. In our clinic, at least, the patients are encouraged to take large quantities of water up to a few hours before the operation, and the patient's normal supper is not only allowed but insisted upon the night before the operation, special provision being made to give an adequate supply of carbohydrates the day before. Thus, while it is possible that some of the early work reported on post-operative acidosis has a real foundation, it is obvious that it does not occur in patients that are neither starved nor dehydrated. Besides the curves here given of the intensive blood chemistry studies, we can back up this assertion by a large number of random CO_2 estimations made post-operatively at varying periods. Acidosis of high degree does not occur post-operatively except as a special complication brought about by prolonged dehydration or prolonged starvation due to inability to retain food, and such complications occur practically always in operations on the intestinal tract in which starvation is necessary, or in patients arriving on the operating table in the condition of acidosis to begin with. In our experience, the carbon dioxide combining power is, in most cases, a far more serviceable index than the blood chlorides as the latter are considerably more variable. This is probably due to the derangement in the gastro-intestinal tract. There is no such compensatory mechanism available for the chlorides as there is for the carbonic acid radical. Excess of carbon dioxide may be breathed out in the lungs and the plasma bicarbonate with its buffer action mechanisms tend to maintain a more or less constant pH . The chlorides, of course, are not volatile and form firm compounds with bases. Such a mechanism is impossible. A secretion of hydrochloric acid to the stomach such as may occur under slight digestive stimuli will produce marked changes in the blood chlorides as will, of course, the absorption or failure to reabsorb chloride ions from the gastro-intestinal tract, which we know is in a most unstable and disturbed condition during the post-operative stage.

Studies of the normal have shown that deprivation of food and water for the periods here considered will not bring about a clinical acidosis in normal

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individuals. The buffer action of the plasma bicarbonates is ample to compensate for this length of time and maintain an approximately normal p^H .

Blood sugar.—It is well known that the effect of ether on an organism is to produce a marked rise in the blood sugar. This is probably due to liver injury and resulting outpouring of glycogen. If ether narcosis be induced in a dog for two to three hours, the blood sugar will rise to over 200 in many cases and glycosuria be produced. In man, the effects of exceedingly prolonged ether narcosis are similar but generally not so intense and glycosuria is rare, although, if it be watched for carefully, it can occasionally be discovered, if the first specimens following the operation are tested. There were no such severe cases of increase in our series, all of the operations being concluded in an hour or less, and in such cases the hyperglycæmic condition is much less marked, although it is practically always present for a few hours after the completion of the operation. But it tends to return to normal fasting levels by about the end of the sixth hour.

We know, of course, that this high blood sugar never reaches toxic levels, but there has been considerable literature of late as to the possibility of hypoglycæmia being a feature of post-operative conditions. The sugar metabolism post-operatively has been discussed at length by us in a previous paper⁷ and the conclusion arrived at that the blood sugar level does not fall low enough in the routine case to require any therapy. In our patients who, as mentioned above, receive ample food before operation, there is never any fall in blood sugar sufficient to lead one to consider such hypoglycæmic toxic condition. It has been shown by one of us that in animals and human beings who are œdematous, blood sugar tends to run higher and the effect of insulin injections is much less.^{8, 9} The evidences of tissue thirst found in our series of Aldrich intradermal salt tests seems to us to point to a slight subœdematous condition, and one is lead to assume that the allocation of water in the tissue is the explanation at least in part of our failure to find low blood sugar. In fasting studies of metabolism it has been repeatedly shown that it is only when the terminal stages are reached that the blood sugar falls appreciably below the normal fasting level such as one finds between meals.

Infection.—There has been an assumption frequently made that minor degrees of sepsis arise in the wound rather frequently although no actual suppuration takes place and the body overcomes the infection and the wound heals normally. It has been said that many bacteria make their way into the organism and that such a degree of sepsis is a factor in many post-operative conditions. The best indices that we have for infection are the number of leucocytes and the temperature. In our cases, the leucocyte count was, as a rule, slightly higher than normal, but under no circumstances were there fluctuations which were large enough to be interpreted as indicative of sepsis. Modern investigation of the mechanism of leucocytosis by Mueller¹⁰ and others has shown clearly that the number of leucocytes in the circulating blood is far from a constant matter. Rapid fluctuations will be found in most cases if counts are made at very short intervals and these fluctuations

are dependent on stimuli of a wide variety of types. Disturbances of the autonomic and sympathetic nerve balance as shown by Petersen¹¹ produced profound leucocytic changes. These probably work through a mechanism of balancing of the peripheral and visceral vascular beds and are related to both the temperature and the body activity as has been suggested by the work of Cannon and the further experiments of Mueller and Petersen¹² on changes produced in chills. Furthermore, as Petersen and Boikan¹³ have shown, the leucocytic and temperature reaction to infection takes place, not at the time of entry of the organism into the blood-stream, but later, after an hour or two, when they are taken up in the reticulo-endothelial system and begin to bring about bodily changes then. The fact that the so-called fibrin fever gives much more of a leucocytosis than a temperature change can be demonstrated quite clearly by the injection of sterile blood. The fact of profound changes in the leucocytes brought about by foreign protein injection is well known and takes on some of the characteristics of foreign protein and it is not at all surprising that the fluctuations of minor character as noted on our charts would occur from such a stimulus.

The temperature after an operation also tends to fluctuate considerably, as the paralysis of the vegetative nervous system renders the organism partially poikilothermic. These fluctuations are of a minor degree only, however, and there is a tendency in the latter part of the twenty-four-hour period to find a slight fall in body temperature, which is probably due to evaporation of water from the pale, clammy skin and can be combated by careful nursing. It has often been pointed out that profound fall in temperature may take place during such a vasomotor paralysis if external heat is not applied or at least attention paid to the maintenance of bodily heat by warm covers. In view of the above, the changes of the leucocytes or the temperature are not of such high grade as to warrant the assumption of any infection occurring.

Dehydration.—As stated above, our patients were provided with an ample supply of water before operation and dehydration to an important degree does not occur. The protein concentration of the blood was measured by the refractometer. (After reading the refractometric index, the protein concentration can be calculated from Reiss's tables.^{14, 15} This protein concentration affords a rather accurate means of estimating the fluid content of the blood. As can be seen from the accompanying charts, fluctuations of considerable degree take place but are always within the range found in normal individuals. This fluctuation is most marked in the earlier stages as evidenced in Charts 1 and 2, which show that there tends to be a slight concentration of the blood following a slight transient fall in the first few hours. This is apparently due to the fact that the patients have lost a moderate amount of water in the urine and sweat before they have been able to absorb much in the stomach. However, it is not to a degree which could be considered pathological. It is interesting here to note that these changes in the concentration of the blood cannot be profoundly influenced merely by administration of fluids.

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With these points in view a series of studies was made by means of the Aldrich-McClure intradermal salt test¹⁶ (see Chart 9), that is, the length of

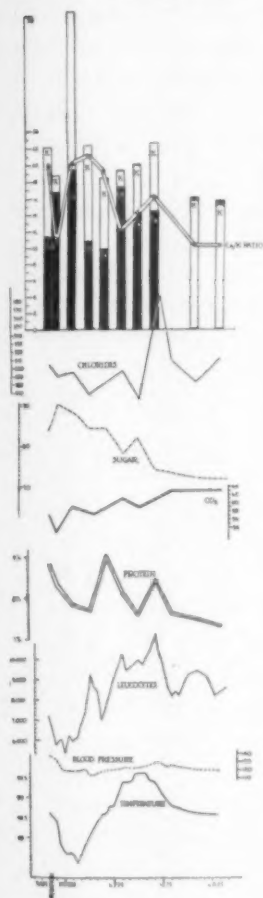


CHART 1.—Interval appendix case. Observations extended from time of operation, 10:00 A.M., continuously until 6:00 A.M. the next day. This was a very difficult case in which McBurney's incision was first made and it had to be very much enlarged. The appendix was dug out of a dense inflammatory mass of old adhesions. The post-anæsthetic sickness was very marked.

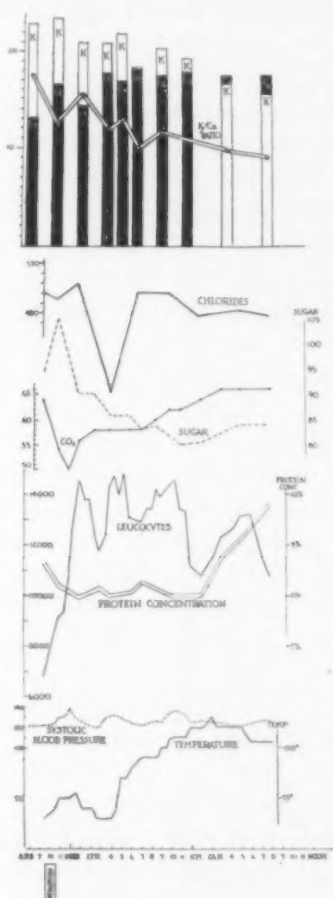


CHART 2.—Subacute appendicitis. Operation through a right rectus incision large enough to admit exploration of the gall-bladder and the uterine adnexa. Observations extended from before the operation until 8:00 the next morning. Post-anæsthetic sickness moderate, but patient felt very badly at the time the observations stopped.

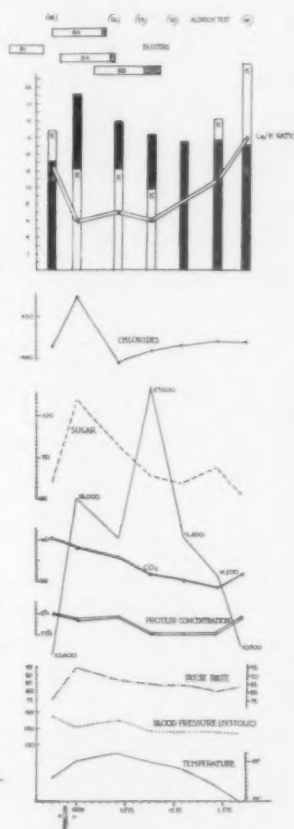


CHART 3.—Excision of inflamed gall-bladder with stones. An uncomplicated cholecystectomy. Operation consumed only 45 minutes. Observations continued until 8:00 P.M. of the day after the operation, nearly 36 hours. Post-anæsthetic sickness was very marked the afternoon and night of the first day, but by noon the next day the patient felt unusually well, for a cholecystectomy case. Note the return of K-Ca values in the blood towards normal the evening of the first day post-operative, corresponding with the improvement in the patient's general condition.

absorption time of an intradermal wheel made by the injection of normal salt solution. This test may be looked upon as an index of tissue thirst, or, the avidity with which water will combine with the proteins of the blood and

the tissues to remain held in fixation by them.¹⁷ In practically every case, while there still appears to be approximately normal amount of water in the body or at least in the blood as measured by the refractometric index, there

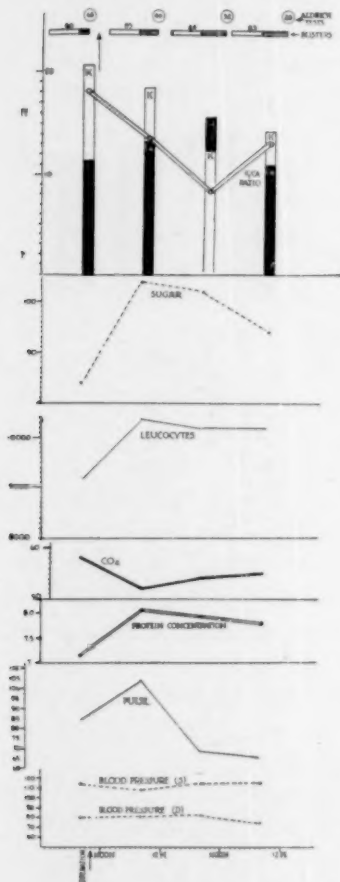


CHART 4.—Cholecystectomy for stones. Operation time about an hour. A very simple case uncomplicated by adhesions, but the patient was very obese, necessitating a large incision and much handling of the viscera. Very severe post-anæsthetic sickness reaching its height about noon the day after operation. Felt very well in the evening and was taking large amounts of fluids by mouth at the time the observations ceased at 10:00 P.M., 36 hours after operation. Note the return of the K-Ca ratio towards normal at the end of the period of observation.

is a marked change in the Aldrich time. It is constantly lessened, indicating an increase in the tissue thirst. It is seen that the colloids become more hydrophilic and tend to hold the water in fixation even in the absence of acidosis, so that the phenomenon cannot be explained simply on the basis of Martin Fischer's theory of œdema. This occurrence is indicative either of changes in the protein complex itself or of surface tension changes, and probably bears a close relation to the changes in the mineral salt balance to be described below.

Blood calcium and potassium ratio.—Estimations of calcium and potassium were made by the method of Kramer and Tisdall.^{18, 19} This was done on seven cases, on three of them at very short intervals (see Charts 1 to 7), and also on three dogs (see the composite Chart 8). In all cases there was the most astonishing change in the mineral salt balance persisting about twenty-four hours. In every case there was an enormous rise in the calcium in the blood accompanied in all severe cases by an equally large fall in the potassium. This was so marked that the ratio, instead of being about 2 to 2½ fell to below 1 on five occasions. In addition to this, a series of three dogs was run in two of which cholecystectomies and in one of which a gastroenterostomy were done under ether anæsthesia. Beginning immediately after the operations blood was drawn at short intervals for calcium and potassium determinations. In each of the experiments the same condition was noted to somewhat the same degree. Examination of Charts 5 and 6 will show the changes in mineral salts of a

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there any evidence of post-anæsthetic sickness except to a very minor degree. Chart 6 shows a very interesting condition in which the opposite of our findings is well demonstrated. The patient was profoundly toxic before the operation with a severe sepsis due to an acute spreading peritonitis originating in the appendix. Our studies thus began at the height of the toxic condition in which the calcium-potassium ratio was inverted and, as the patient returned rapidly to normal, the restoration of the normal mineral salt balance took place.

These changes were first noted by us about two years ago and the preliminary report was issued at that time. Very shortly thereafter appeared

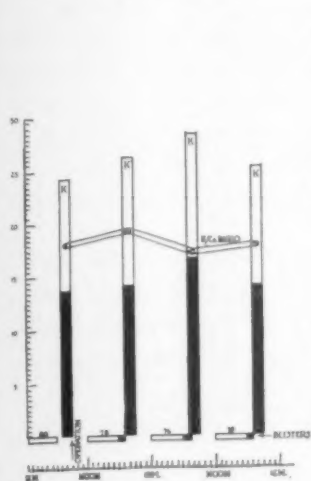


CHART 5.—A partial hysterectomy for small fibroids. Almost total absence of post-anæsthetic sickness. Patient was able to take fluids the same night. The pain minimal. Observations extended until 10:00 the next morning, 24 hours after operation. Only slight change in the calcium.

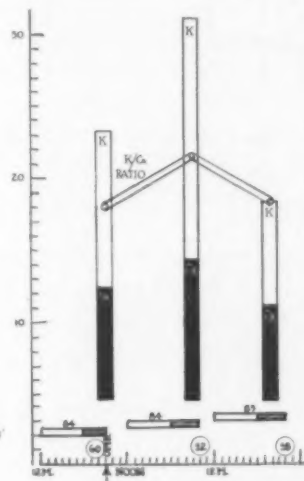


CHART 6.—Right inguinal herniotomy. Operation time 25 minutes, with minimum of trauma necessary. Simple sac excision, suture of the endo-abdominal fascia and closure. The anesthesia was light. Practically no post-anæsthetic sickness. Negligible changes in the mineral salt ratio in spite of sharp rise of calcium, but it was compensated for by equally great rise in potassium. Return to normal in 36 hours.

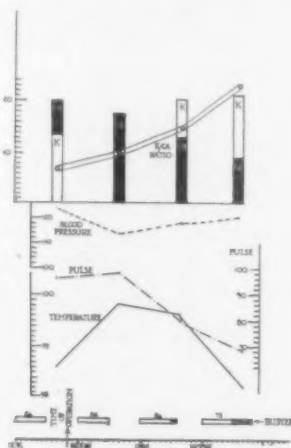


CHART 7.—Case of general peritonitis due to a ruptured appendix of 24 hours duration. Patient exceedingly toxic and drowsy on entrance. Emergency operation with blunt removal of gangrenous appendix, suture of colon over the gangrenous stump and no closure of wound to permit extensive drainage. Observations continued for 37 hours. Note the fact that the marked changes in the K-Ca ratio had begun at the time of the operation and there is prompt return to normal with the recovery of the patient.

the important paper of Emerson²⁰ on the calcium in the blood in ether anæsthesia and shock. He found a consistent rise in the blood calcium of 18 to 20 per cent. following etherization. Unfortunately, no potassium studies were made. In his experiments the animals were etherized and maintained for one hour in the second stage of anæsthesia, blood calcium being taken immediately before and after. In spite of the fact that the maximal point of the curve was not studied as it was in our work, very marked changes were noted. In his experiments he also added operative procedures in some cases and found that the rise in calcium was no greater, thus in his opinion elimi-

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nating the feature of shock as a factor. He noted also a similar marked rise if asphyxia was brought about.

Our findings are by far the most profound changes in the mineral salt balance that have ever been reported, except in a very few isolated cases.

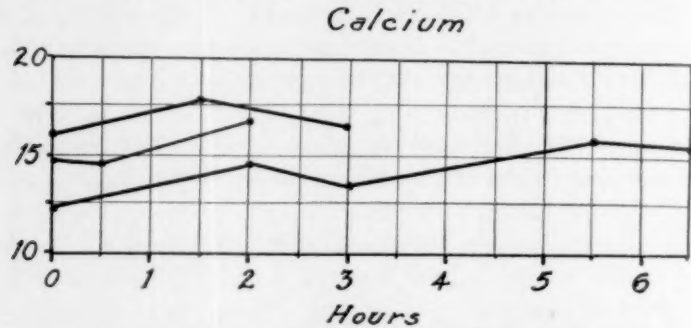


CHART 8.—The blood calcium curves of three dogs; Numbers 1 and 2, cholecystectomies under ether, and Number 3, gastroenterostomy under ether. Note the rise in the calcium in all cases. Potassium estimations were not made on these sera as the hemolysis was considerable. Unfortunately the studies were not carried out for a long enough time to reach the peak of the curve as shown in Charts 1-4.

Studies of blood calcium and potassium have for the most part been made in chronic experiments in which at the most daily determinations were made. This is true of practically all of the work on deficiency diseases and in the disturbances in parathyroid metabolism. Our findings, however, have been

ALLRICH-McCLURE INTRADERMAL SALT TESTS

	Pre-operative	6-8 hours Post-operative	20-24 hours Post-operative
1.....	50	35	78
2.....	49	45	39
3.....	68	60	47
4.....	54	41	59
5.....	50	37	42
6.....	53	36	49
7.....	43	32	47
8.....	57	39	47
9.....	53	42	49
10.....	50	38	61
11.....	45	41	41
12.....	61	51	49
13.....	58	32	37
14.....	49	29	30
15.....	50	43	51
16.....	44	35	39
17.....	52	33	33
18.....	53	33	50
19.....	61	53	41
20.....	59	40	35

CHART 9.—Absorption time of one-half cubic centimeter of intradermally injected normal salt solution. These observations were made on twenty consecutive cases of ether anaesthesia in the wards of St. Luke's Hospital on patients who were operated on outside of emergencies.

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somewhat paralleled in a few instances, notably those of the experiments of Petersen²¹ and Mueller on anaphylactic shock; those of Kylin²² in a few instances and in the studies of Salvesen²³ on permeability. There is a report of several cases of erythema exudativum multiforme in which the potassium actually fell below the calcium values in the blood. In these studies by Nathan and Stern²⁴ the authors have put exclamation marks in their tables after these hitherto unknown findings, as if to cast doubt on the accuracy of their own work.

Salvesen²⁵ has reported certain experiments in which the dog was etherized for an hour and the blood calcium taken immediately before and immediately after the experiment and then again in twenty-four hours. In his table the blood calcium rose .34 milligrams during that hour and had fallen considerably at the end of twenty-four hours. A glance at our tables will show at once that the taking of only two samples following the anæsthesia would naturally completely miss the phenomenon noted by us.

Permeability.—In view of these very striking observations, the studies of the permeability were undertaken according to the method reported by

PERMEABILITY TESTS				
	Pre-operative	6-8 hours Post-operative	16 hours Post-operative	20-24 hours Post-operative
1.....	82	84		88
2.....	68	72	76	78
3.....	81	84		88
4.....	80	85	84	83
5.....	73	76		80
6.....	69	75		79

CHART 10.—The ratio of the protein in the blister fluid to the protein in the blood serum of six patients following ether anæsthesia taken at various times before and after operation. Note the constant rise in the permeability index in all the cases. See also Charts 3, 4, 5, 6, and 7.

Gaennslen²⁶ and afterward elaborated by Petersen.^{27, 28} A cantharides blister was applied to the skin and the time taken for blistering noted together with the observation of the protein content of the blister fluid and the patient's serum, according to the method described by the latter authors. I am indebted to Doctor Petersen for his kind assistance in this work.

In a series of six cases studied by us, most profound changes in the permeability were noted. Our findings (see Chart 10), are expressed in terms of the permeability ratio, that is, the protein content of the blister fluid divided by the protein content of the blood serum. In every case there was a marked rise in the permeability as measured by this index and in each case also there was the unusual finding of a lengthening of the time it took the blister to form. These findings of a constantly increasing permeability we believe of profound importance in relation to the very low calcium-potassium figures already reported and point perhaps to a reflection as to the possible source of the calcium found in the blood-stream. Although there is a lengthening of the blister time, denoting the fact that less blood is getting to the

skin, an observation which can be amply confirmed by a glance at the pallor of the skin. The skin proves to be more permeable and one is tempted to assume that there is a passage of calcium from the skin and musculature and bone, that is, the peripheral vascular fields, to the internal organism as a protective mechanism against the changes in the cell membrane brought about by the dissolution of lipoids by the ether.

Discussion.—It is well known since the pioneer work of Loeb that the activity of the individual cell can be profoundly influenced by the mineral salt balance of the surrounding medium. A consideration of the concentration of the various ions themselves is not of such importance as the ratio between these ions. The monovalent ions are generally present to about two or two and a half times the number of bivalent ions. An increase in the bivalent ions (calcium and magnesium) in relation to the monovalent ones (sodium and potassium) causes a lessening of the permeability of the cell. Its membrane, which is probably the condensation layer a single molecule thick of a protein-lipoid complex, behaves very differently in different concentrations of these ions. It was formerly thought that the mineral salts themselves were included in this protein-lipoid complex but recent work showing that certain cells at least are free from calcium ions renders it more probable that the mineral salts are of importance merely in maintaining the proper osmotic relation to the surrounding media. A very large section of the modern literature in biology has to do with such permeability studies. An increase in potassium ions causes an increase in the permeability of the cell. Its metabolism is speeded up and substances make their way through the cell membrane much more rapidly. Dyes, food substances can be seen to pass in and out of the cell with far greater rapidity as the potassium calcium ratio is raised and if it is raised beyond definite limits the cell membrane becomes so permeable that it can no longer restrain the normal contents of the cell and dissolution and death take place. Exactly the opposite takes place if the calcium ion is increased. Then the cell membrane becomes impermeable and substances cannot make their way in and out of the cell. The cell "freezes" and lies dormant, all its interchange with the outer world having ceased, if the calcium ion increase is carried far enough.

It is quite suggestive to realize that unicellular animals could not survive for any length of time in the media the mineral salt balance of which is disturbed to such an extent as we have found in all post-operative cases. Such a cell would lie dormant for a period following which there is coagulation of the cytoplasm and death. Certainly such changes in the media in which the colonies of cells which make up the human organism lie are more than amply sufficient to account for the changes observed in patients post-operatively.

Since the early work of Eppinger,^{29, 30} it has become very evident that many of the vegetative functions of the organisms are under the control of the autonomic and sympathetic nervous systems as a balancing unit and that profound changes in many of the metabolic functions are controlled in this

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manner. Vagotonia is the term applied to one extreme condition in which most of the inhibitory fibres of the vegetative nervous system are in a hyperactive state and sympathicotonia to the opposite condition. The studies of Schlee, Mueller, Petersen, Salvesen, Kylin, and other observers together with Eppinger himself have shown the close relation between autonomic and sympathetic nerve balance and the certain blood chemical features. The vagotonic tends to run to hypercalcaemia and the sympathetotonic stands at the opposite end of the scale. While it would probably be an unwarrantable assumption that the post-anæsthetic sickness is one simply of vagotonia, our findings certainly point to that side of the scale.

According to Hawk and Bergeim,³¹ the total amount of calcium circulating in the human system is only about 600 milligrams. In view of the solubility of any of the calcium compounds found in bone and other tissue, the mechanism by which it is kept in place is difficult to understand. One is tempted to assume that with the administration of such a powerful lipid solvent as ether, the lipoids are brought out of the cell membranes, thus producing profound disturbances in the cell permeability, and that under such conditions there is a call on the calcium so that it is drawn into the blood in overwhelmingly large amounts to compensate for the loss of the lipoids and to keep the interchange between the cell and tissue fluids on a normal basis. As the calcium is probably held in place at least partly by lipid cell membranes, it is not surprising that such a readjustment would take place almost automatically. This would also explain the marked increase in permeability of the skin of a condition where the calcium in the circulating media is abnormally high, where one would naturally expect the opposite to take place. One might again assume that the solution of the lipid complex in the cells in the skin is the primary lesion from the ether in the blood and the hypercalcaemia represents a compensatory reaction to maintain as nearly as possible more normal permeability in the capillaries in the internal organism.

Finally, our observations on the water balance in post-operative states suggests that the routine treatment by the injection of physiological salt solution may bring about its improvement more by the giving of monovalent ions than through the water administered. Clinical experience shows beyond the shadow of a doubt that patients feel very much better on administration hypodermatically or intravenously of normal salt solution, and in my own experience the administration of tap water through rectum proved valueless unless the patient was really severely dehydrated. The evidence, therefore, is somewhat suggestive that what our patients need is not water, but salt, and clinical experience tends to bear this out.

SUMMARY AND CONCLUSION

1. Intensive post-operative blood chemical studies were made on patients for twenty-four to thirty-six hours after operation.
2. There were no significant changes in the leucocytes, blood-pressure,

temperature, pulse, blood sugar, water content of the blood, or chlorides or carbon dioxide.

3. Marked changes were found in the Aldrich-McClure test indicative of increased tissue thirst.

4. Tests of permeability of the skin showed that this was much increased.

5. Profound changes in the mineral salt balance were noted. The potassium calcium ratio often fell to below one. These changes *per se* may be considered adequate to account for the condition known as post-anæsthesia sickness.

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